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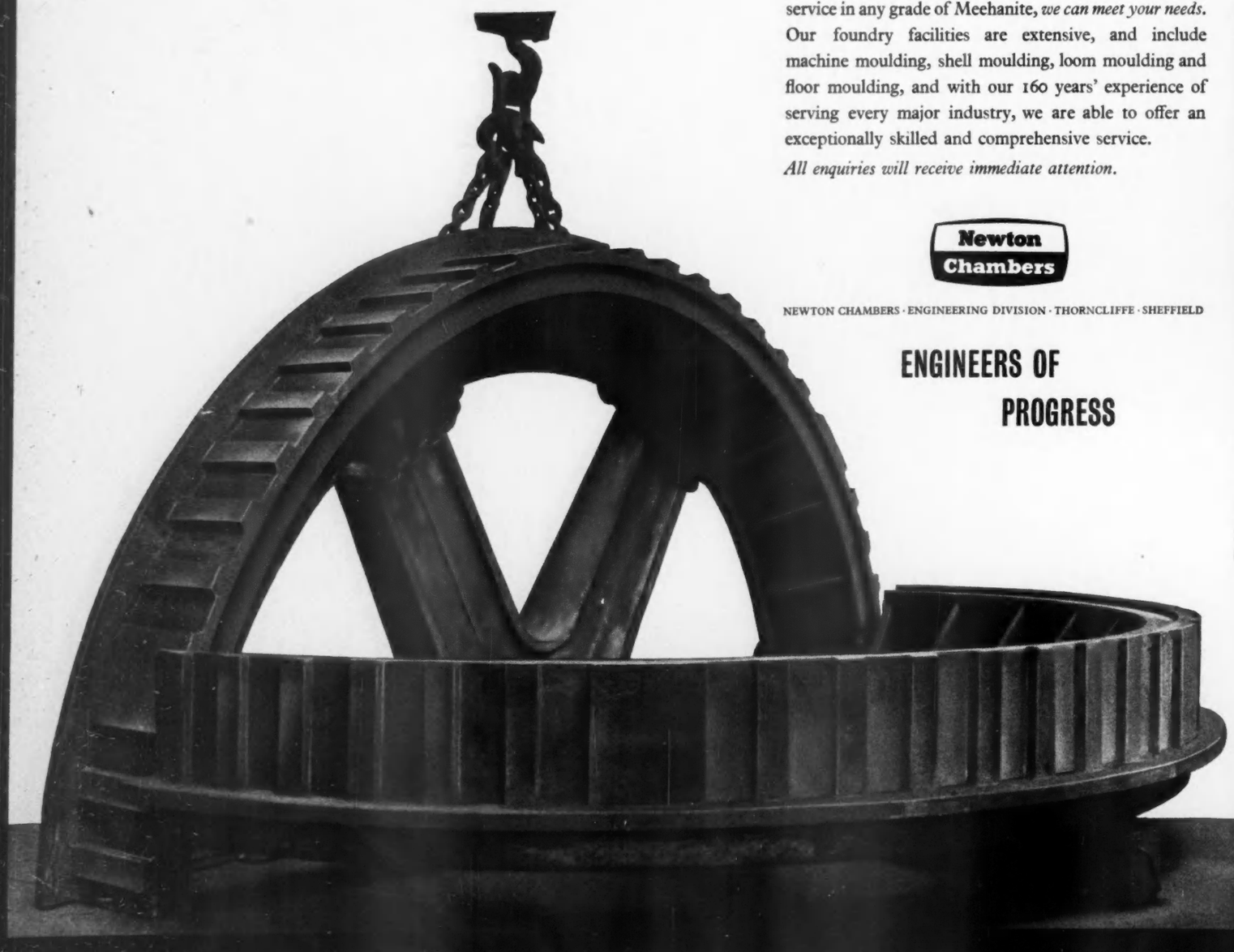

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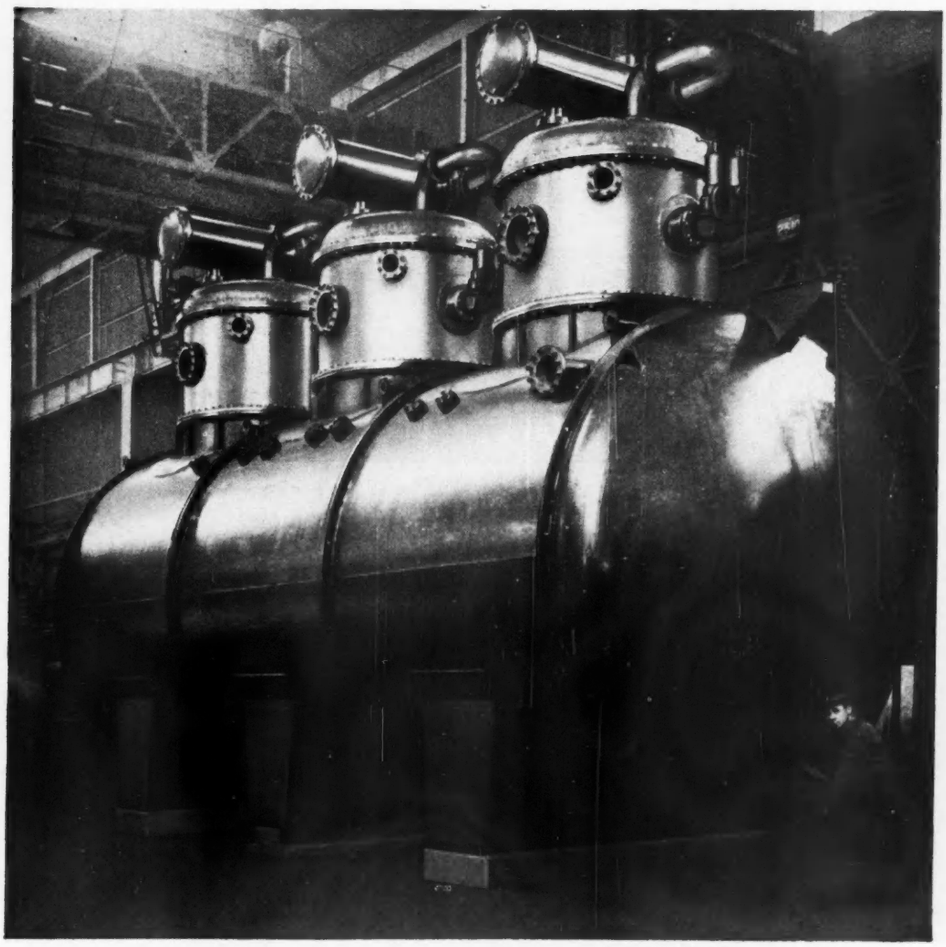

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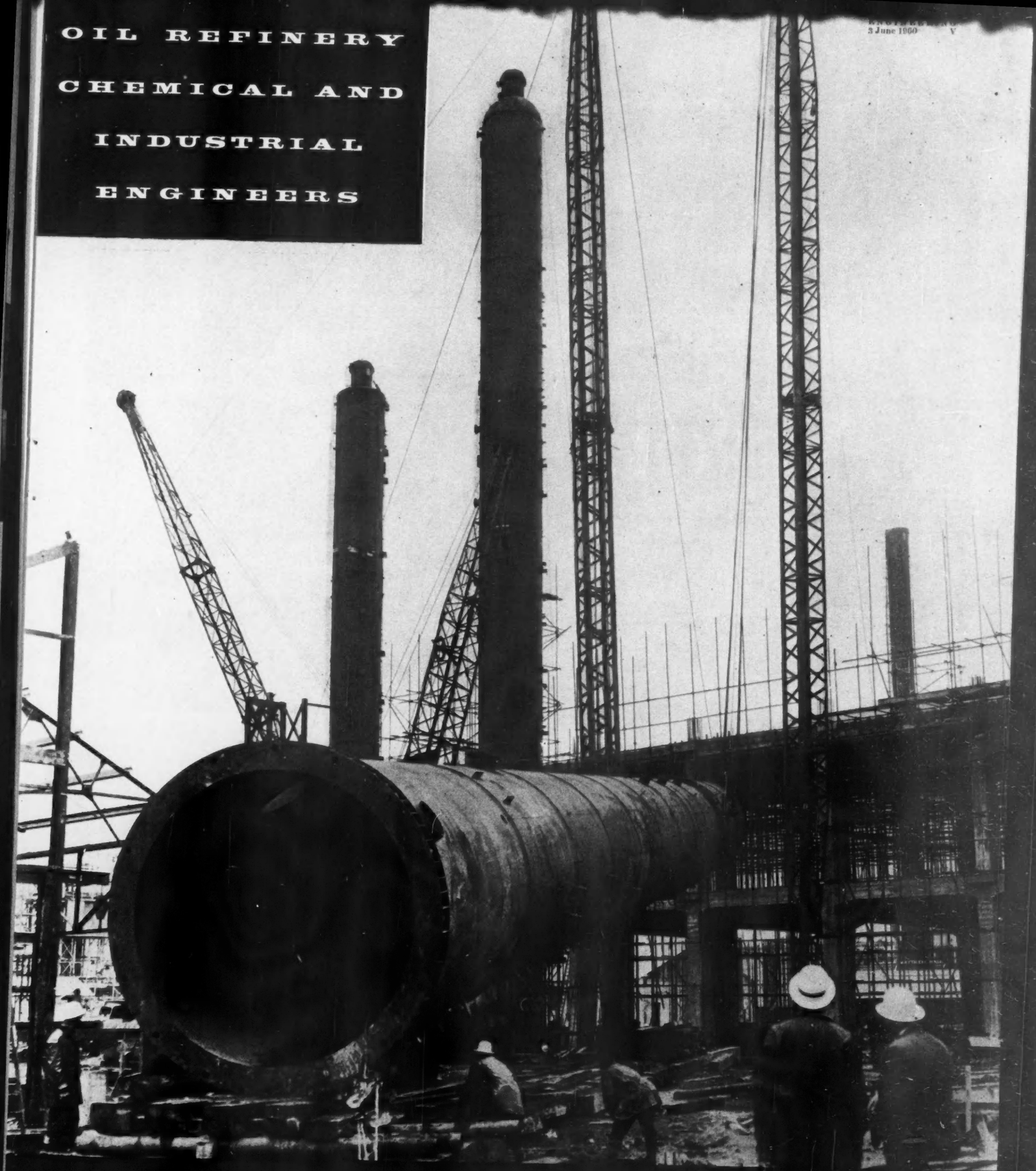

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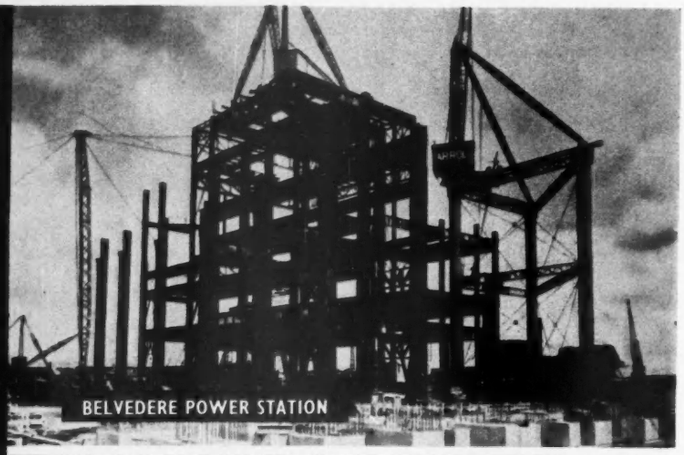

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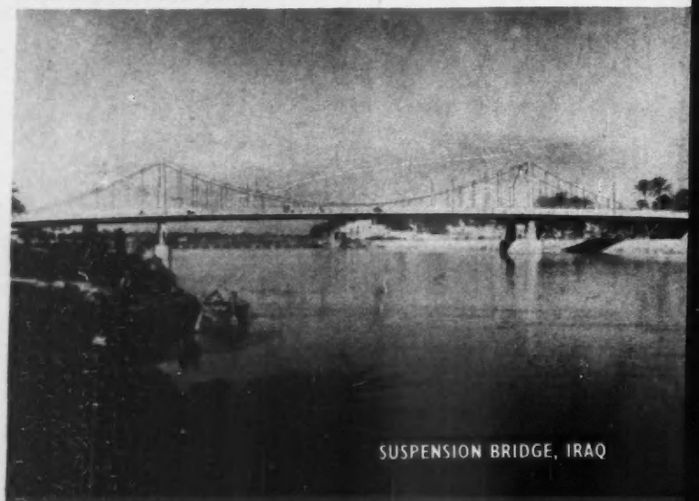

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Contents

742 Metals and Materials

Your Chromium Will Soon Last Longer

746 New Plant and Equipment

Computer, Loader, Free Standing Store, Twin Power Scraper, Motor Brake, Motor Controller, Reel Lifter, Packaged Boiler, Photo Painter, Laboratory Mixer, Work Bench, Drip Regulator

752 Construction

Economies with Composite Construction
By F. A. Lefever

Road-Rail Plan for Copenhagen, Finding out More about Canada's Permafrost, Multiple-Drill Barge for River Work

758 Production

Bending Cold Plate for Pressure Vessels

Automatic Recording of Production, Extruding Brittle Materials, From Cars to Machine Tools, Cold Extrusion of Titanium, Standard for Metal-Arc Welding, Automatic Temperature Control for Sintering, New Machine Cheapens Laminated Sheet, Machine Tools for China

760 Operation and Maintenance

Engineering Service for the Collieries

Central Vacuum Cleaning Plant for Television Centre, Power and Light for the Nation, Cranes through a Culvert

766 Design

Radial Turbines for Small Power Plants

Mach 3 Aircraft—Recognising the Snags, Hydraulic Nut Eliminates Torsional strain, Fan-Cooled Hubs Assist Aircraft Braking, Lighting Jamaica's Palisadoes Airport

769 Research and Development

Evolving High Speed Railway Drawgear

More Light on Air Bearings, Optimum Power for Electrical Steelmaking

741 Impact

749 Human Element

757 Companies

765 Marketing

Special Articles

748 Upward Trends in Europe's Electricity

750 Cunning and Colour at New York Exhibition

754 Automobile Review

Compact Quality Cars Will Sell Overseas
By John Rabson

755 Atomic Review

Space-Bound Reactors

772 At Home

On the Tape

744 Plain Words

744 Letters to the Editor

Scottish Students go South
Ian Gordon
Draughts in the Room
D. H. Keene
Developments in Wales
Gerald S. F. Ritson
Thermodynamic Theory
Sven Svantesson

745 Events in Advance

762 Publications

On the Shelf
By Frank H. Smith
Jet Propulsion Engines
Advanced Aero Engine Testing
Explosions, Detonations, Flammability and Ignition
The Four Window Girl
The Scientific Background
Package Design Engineering
New Books and Trade Publications

Cover Picture

Testing an aircraft hydraulic landing gear component to check that it complies fully with the specification. (*Nurnberg photograph for* ENGINEERING.)

Subscription Rates: Editorial page 772

Index to Advertisements: Overleaf

Engineering Appointments Section: Faces Editorial page 756

Advertisers in 'Engineering' this week

	PAGE
Adamson, J., & Co., Ltd.	46
Allday, W., & Co., Ltd.	71
Allen, A. H., & Co. (Engineers), Ltd.	35
Amal, Ltd.	59
Andrews Toledo, Ltd.	5
Armstrong Stevens & Son, Ltd.	59
Arrol, Sir William, & Co., Ltd. *Wrapper*	VI
Associated Electrical Industries, Ltd. Motor & Control Gear Division	72
Transformer Division	38
Atlas Copco A.B. (Sweden)	41
Austin, E., & Sons, (London,) Ltd.	8
Barry, Henry, & Cook, Ltd.	15
Begg, Cousland & Co., Ltd.	68
Berry, H., & Co., Ltd.	66
Blakeborough, J., & Sons, Ltd.	53
Booth, Joseph, & Bros.	33
British Railways	68
British Ropeway Engineering Co., Ltd.	65
British Steam Specialties, Ltd.	10
Brown, D. Corpn. (Sales) Ltd.	23
Brown, E. G., & Co., Ltd.	46
Brown, N. C., Ltd.	67
Burtonwood Eng'g. Co., Ltd.	62
Bury Felt Mfg. Co., Ltd.	47
Carruthers, J. H., & Co., Ltd.	36
Centrax, Ltd.	15
Chesterfield Tube Co., Ltd.	30
Clyde Crane & Booth, Ltd.	33
Clyde Crane & Eng'g. Co.	33
Clyde Rubber Works Co., Ltd.	8
Conveyor & Elevator Co. (1936) Ltd.	10
Crane Packing, Ltd.	60
Crofts (Engineers) Ltd.	17
Crossley Bros., Ltd.	34
Dallow Lambert & Co., Ltd.	48
De Havilland Propellers, Ltd.	39
Elliron (London) Ltd.	4
Empire Rubber Co.	62
"Engineering" Quick-binde	12
"Engineering" Reprints	4
Falk, Stadelmann & Co., Ltd.	69
Fenner, J. H., & Co., Ltd.	57
Firth, Thos., & John Brown, Ltd.	45
Firth Brown Tools, Ltd.	21
Firth-Vickers Stainless Steels, Ltd.	31
Flexible Ducting, Ltd.	6
Fordsmith, H., Ltd.	46
Gas Council. *Wrapper*	VIII
General Eng'g. Co. (Radcliffe) Ltd.	33
Glacier Metal Co., Ltd.	7
Godfrey, Sir G., & Partners (Industrial) Ltd.	27
Grafton Cranes, Ltd.	64
Head, Wrightson Processes Ltd.	28
Heap, J., & Co., Ltd.	30
Heenan & Froude, Ltd.	15
Herbert, A., Ltd.	35
Hockley Foundry Ltd.	4
Holman Bros., Ltd.	40
Hudswell, Clarke & Co., Ltd.	8
Hunt Heat Exchangers, Ltd.	2
Ilford, Ltd.	61
Imperial Chemical Industries, Ltd. Fibres Division	11
International Combustion Products Ltd.	20
Iso-Speedic Co., Ltd.	52
Lilleshall Co., Ltd. *Wrapper*	VII
Lintott, H. & E., Ltd.	68
Lockheed Precision Products, Ltd.	55
Londex, Ltd.	35
McNeil, C., Ltd.	6
MacLellan, P. & W., Ltd.	10
Marston Excelsior, Ltd.	59
Massey, B. & S., Ltd. *Wrapper*	VII
Mather & Platt, Ltd.	47
Matthew Hall & Co. Ltd. *Wrapper*	V
Mavor & Coulson, Ltd. *Wrapper*	IV
Mek-Elek Eng'g., Ltd.	65
Metalastik, Ltd.	49
Micanite & Insulators Co., Ltd.	65
Monk, A., & Co., Ltd.	37
Morris, B. O., Ltd.	70
Mountford, F. (Birmingham) Ltd.	14
Mountford, J., & Co., Ltd.	12
Newbury Diesel Co., Ltd.	15
Newton, Chambers & Co., Ltd. *Wrapper*	II
Norris Bros., Ltd.	15
Osborn, S., & Co., Ltd.	54
Palnut Co., Ltd.	64
Parks Forge, Ltd.	15
Parsons, C. A., & Co. Ltd.	18
Peglers, Ltd.	67
Plenty & Son, Ltd.	9
Plowright Bros., Ltd.	26
Power Auxiliaries, Ltd.	32
Pratchitt Bros., Ltd.	12
Reavell & Co., Ltd.	67
Reed Crane & Hoist Co., Ltd.	14
Renold Chains, Ltd.	56
Reyrolle, A., & Co., Ltd.	16
Roberts, J. W., Ltd.	2
Robson, G., & Co. (Conveyors) Ltd.	62
Rocol, Ltd.	63
Rolls-Royce, Ltd.	64
Saunders Valve Co., Ltd.	71
Scriven Machine Tools, Ltd.	65
Sentinel (Shrewsbury) Ltd.	64
Serck, H. O., Ltd.	62
Simon, R., & Sons, Ltd.	43
Simon-Carves, Ltd.	50 & 51
South Durham Steel & Iron Co., Ltd.	19
Sterling Safway Scaffolding	24 & 25
Tangyes, Ltd.	58
Taylor & Hubbard, Ltd.	30
Taylor Industrial Clutches	10
Tecalemit, Ltd.	44
Tonks, J., & Co., Ltd.	8
United States Metallic Packing Co., Ltd.	4
Venus Pencil Co., Ltd.	8
Waller, G., & Son, Ltd.	29
Ward, Thos. W., Ltd.	42
Weir, G. & J., Ltd. *Wrapper*	III
Wellman Bibby Co., Ltd.	29
Wellman Smith Owen Eng'g. Corpn., Ltd.	32
Westwood, J., & Co., Ltd.	71
Whitehouse Industries, Ltd. Philidas Division	22
Wiggin, H., & Co., Ltd.	13

'Engineering' Appointments Section

British Railways	1
Central Electricity Generating Board	2
The Glacier Metal Co., Ltd.	4 & 5
Hardy Spicer, Ltd.	3
Management Selection Ltd.	4
Mudi River Water Board	4
North West Metropolitan Regional Hospital Board	2
Norris Bros., Ltd.	4
Rhodesian Select Trust Group	6
Royal Arsenal Co-operative Society Ltd.	6

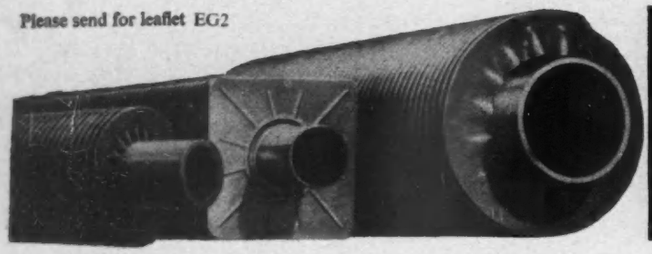
Classified Trade & Technical

Bell, H. (Machine Tools), Ltd.	3
Cohen, George, Sons & Co., Ltd.	3
Debenham, Tewson & Cainnocks	4
Edwards, F. J., Ltd.	3
Mayer, Newman & Co., Ltd.	4
Plint & Ptns., Ltd.	3
Research Engineers, Ltd.	3

Company Meetings

Guest, Keen & Nettlefolds, Ltd.	6
Ransomes Sims & Jefferies, Ltd.	6

Please send for leaflet EG2



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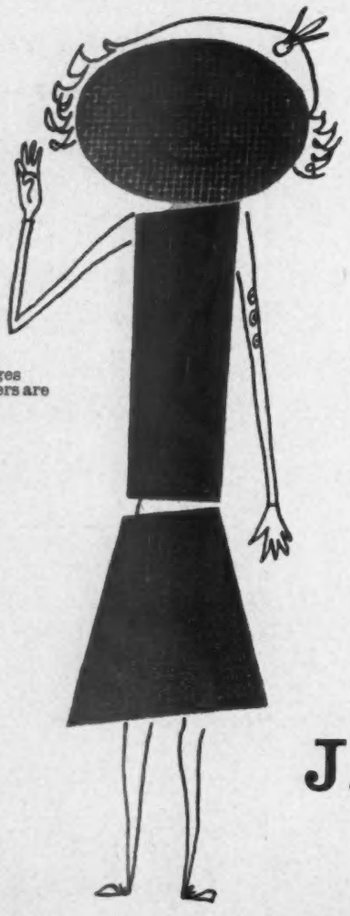

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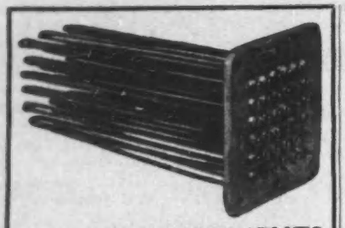

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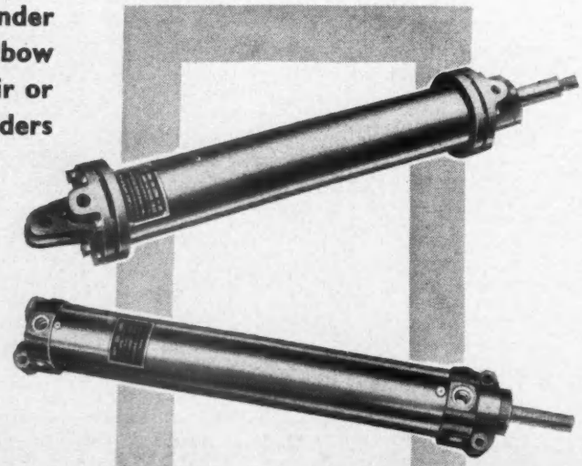

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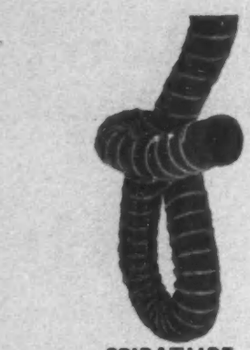

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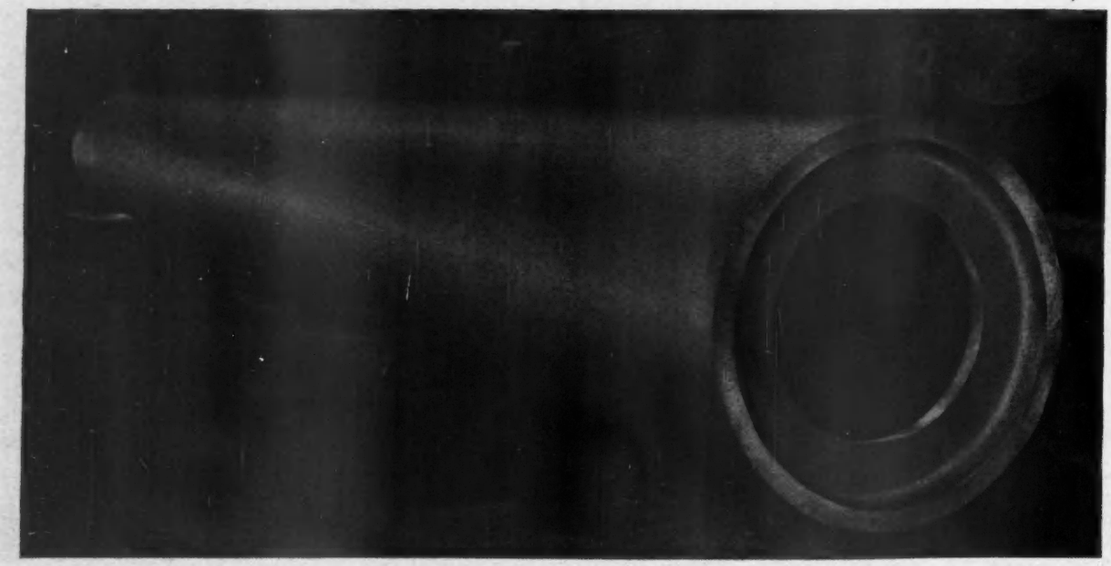

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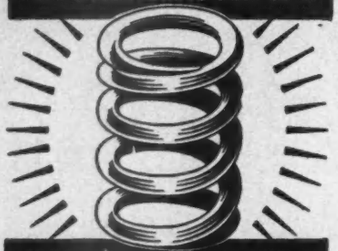

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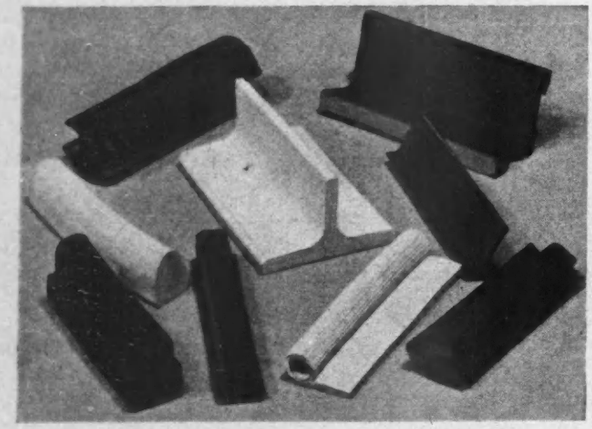

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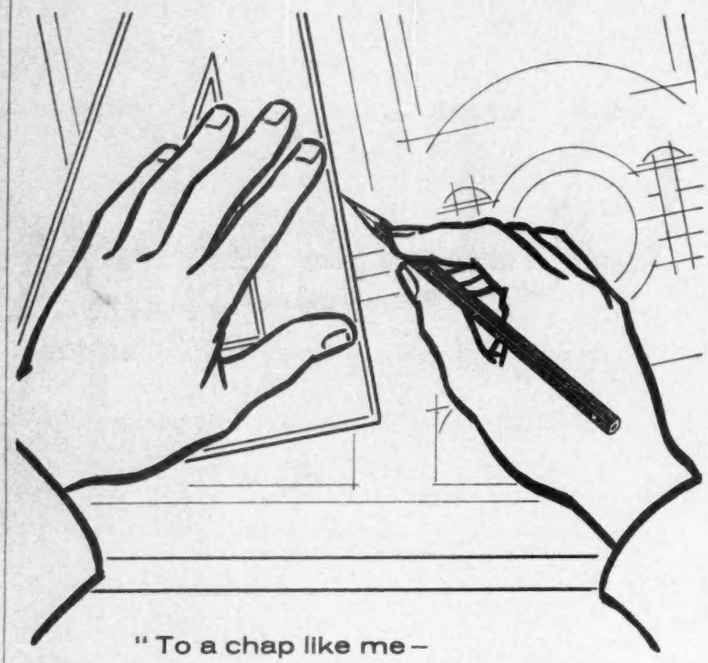

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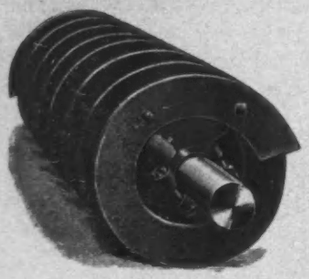

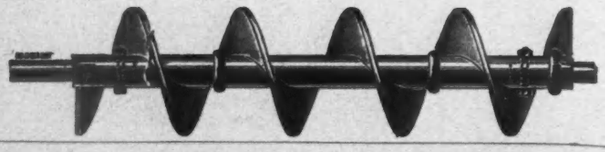

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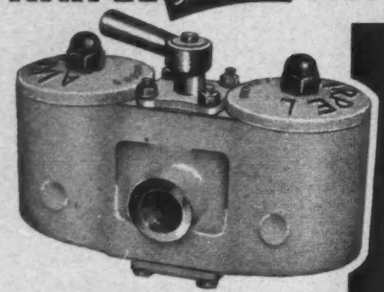

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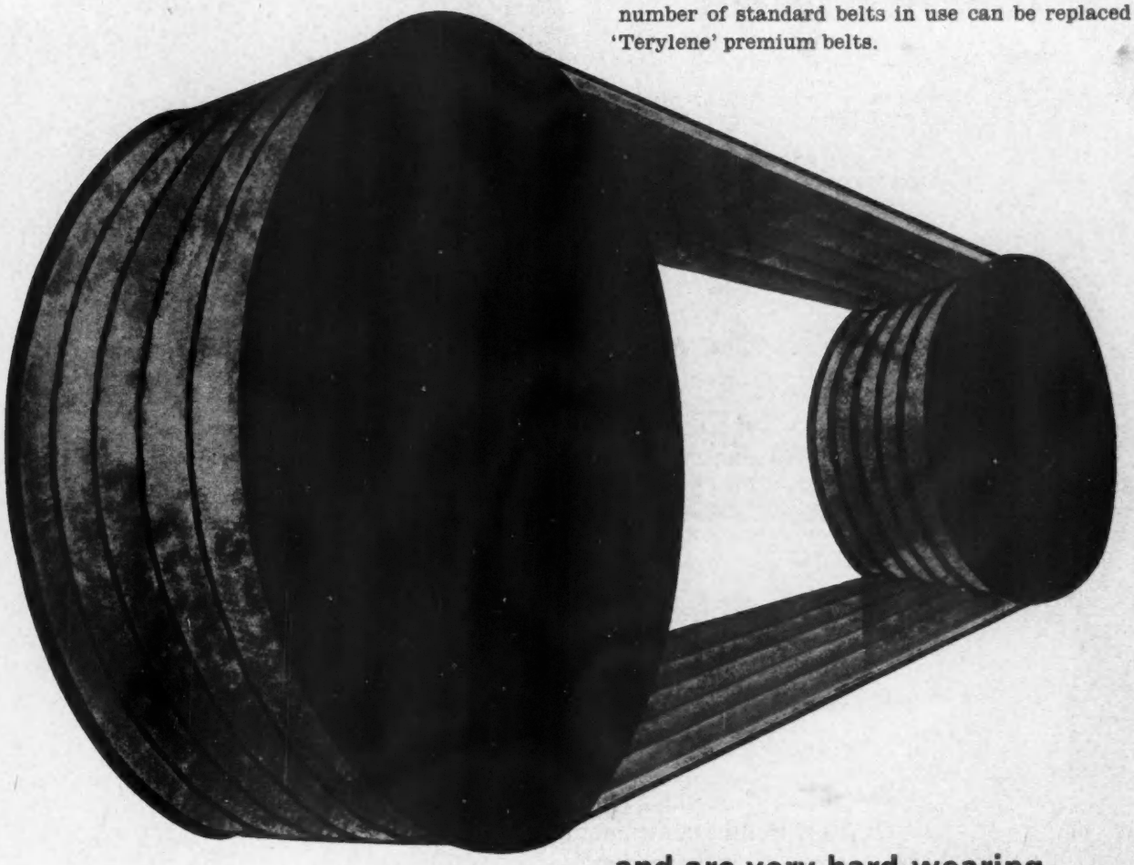

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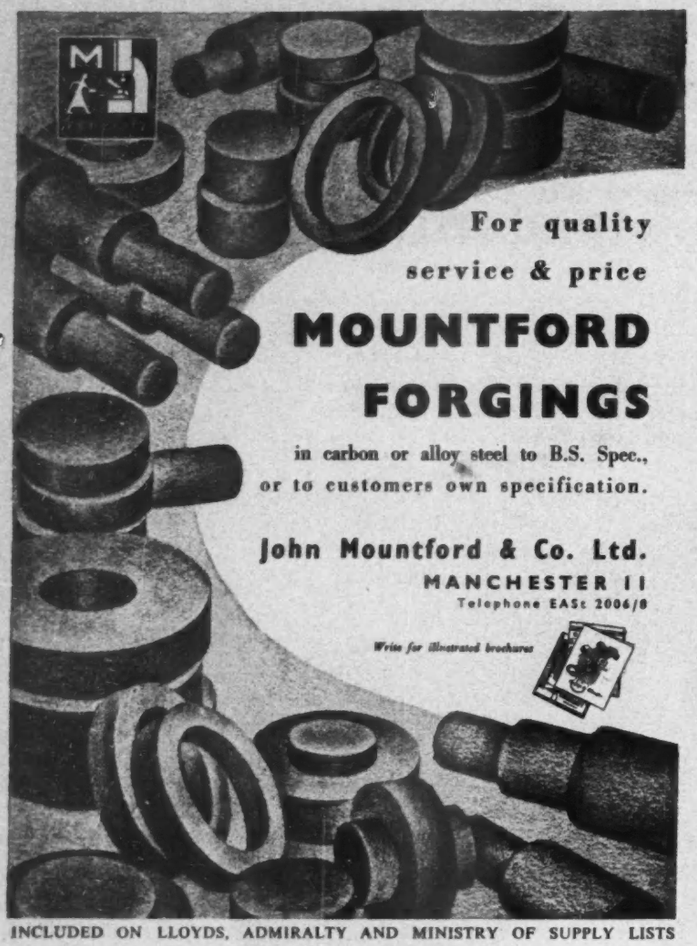

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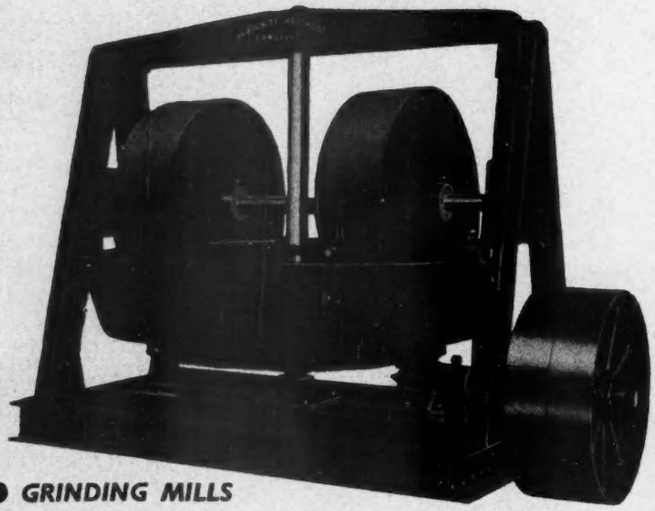

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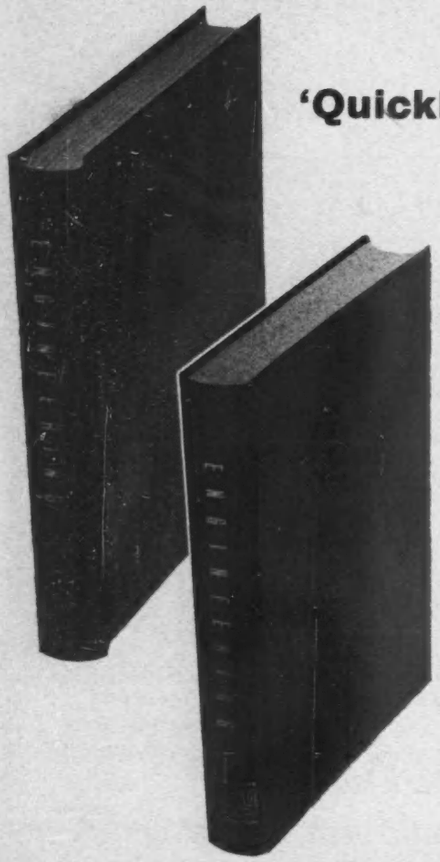

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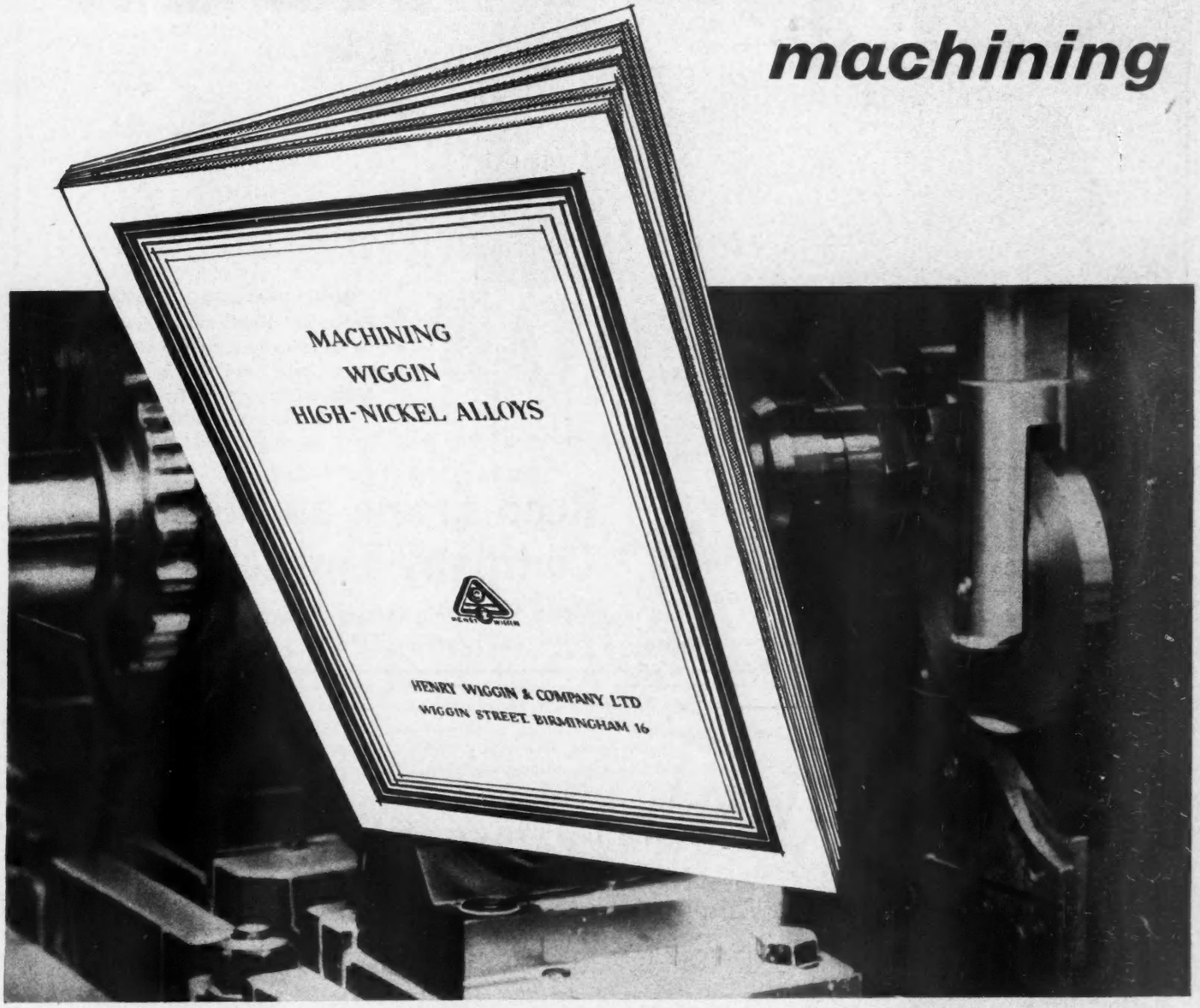

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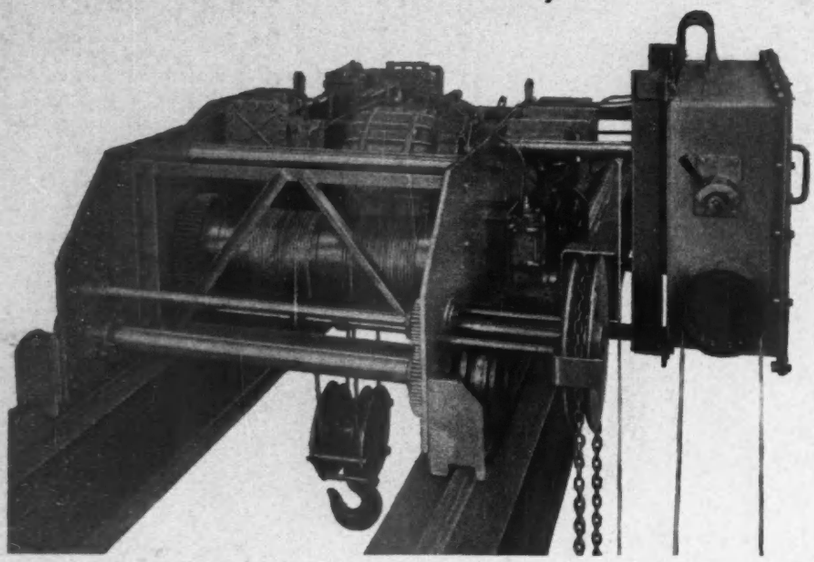

'RCH' FLAMEPROOF equipped Cranes and Hoists can be designed for operation in any group of gases, or corrosive and heavily steam-laden atmospheres, or for handling — with precision — highly explosive and inflammable materials.

E.O.T. Cranes up to 50 tons S.W.L. and 100 ft. span
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Jib Cranes, Goliath Cranes,
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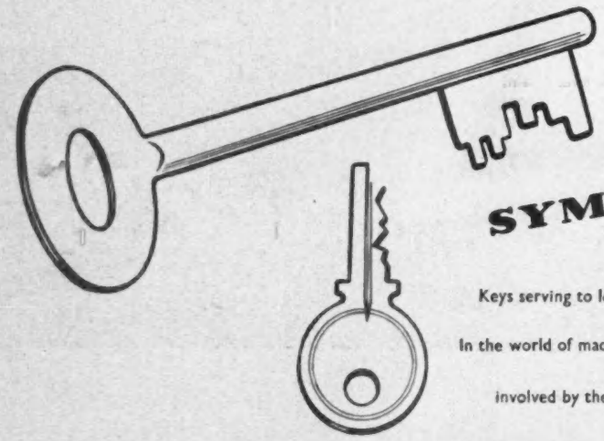
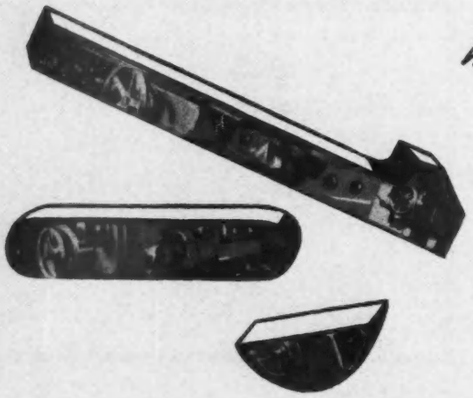


SYMBOLS OF SECURITY...

Keys serving to lock out, as well as in, can be regarded also as symbols of freedom from things unwanted. In the world of machinery, freedom from breakdown, from inaccurate working, and from the extra expense involved by the presence of these two undesirables, gives the best possible security for efficient production.

BUT FOR KEY APPLICATION TO MACHINES

make doubly sure by fitting



HEADED, PLAIN AND WOODRUFF KEYS
Also manufacturers of
SOLID AND SPLIT TAPER PINS

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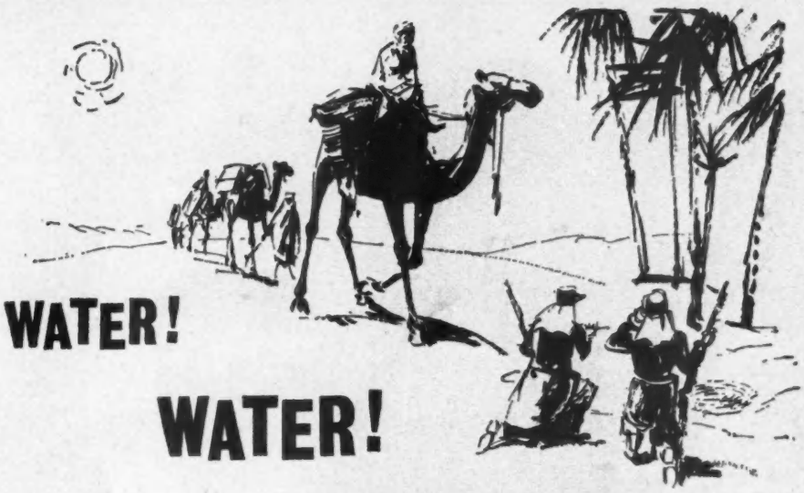
FREDERICK MOUNTFORD (B'ham) LTD.
FREMO WORKS · MOSELEY ST. · BIRMINGHAM, 5

Telephone: MIDland 7984 PBX. Telegrams: FREMO, BIRMINGHAM



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NOW

IS THE TIME TO PREPARE FOR THIS SUMMER

HEENAN Water Coolers

ELIMINATE SHORTAGES, LOSS OF PRESSURE, RATIONING

1959 saw one of the greatest shortages of water that this country has ever experienced. It could happen in 1960—or any other year.

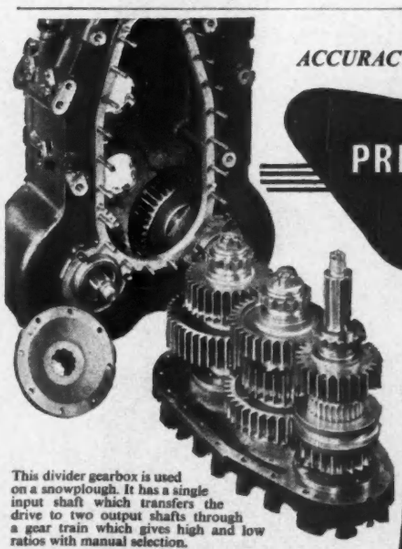
Do not risk your output being hampered or your business shut down, through reduction of town-water pressure, or actual cutting-off of supplies.

The Heenan Water Cooler uses the same cooling water over and over again. Be independent of the town's water supply—INSTALL NOW. Apart from all these advantages

THE HEENAN COOLER QUICKLY PAYS FOR ITSELF

H&F

HEENAN & FROUDE LTD., ENGINEERS, WORCESTER



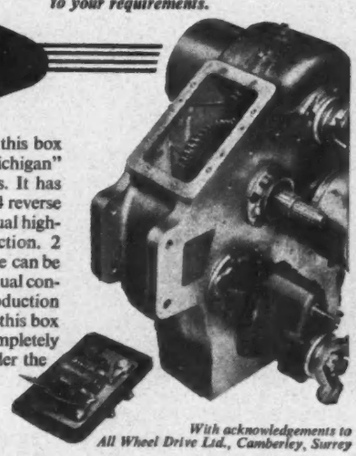
This divider gearbox is used on a snowplough. It has a single input shaft which transfers the drive to two output shafts through a gear train which gives high and low ratios with manual selection.

ACCURACY AND QUALITY ON A PRODUCTION BASIS

Produced to your own specification or designed by us to your requirements.

PRECISION GEARING

3 versions of this box are used on "Michigan" Tractor Shovels. It has 4 forward and 4 reverse gears with manual high-low range selection. 2 or 4-wheel drive can be selected by manual control. Since production started in 1958 this box has proved completely trouble-free under the most arduous conditions.



With acknowledgements to All Wheel Drive Ltd., Camberley, Surrey

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CENTRAX LIMITED, Newton Abbot, Devon

Sales Office: 248-250 Tottenham Court Road, London, W.1. LANgham 2364/5

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have teams available for

DESIGN, DETAILING and DEVELOPMENT in *ALL* branches of Engineering

TECHNICAL INVESTIGATIONS & REPORTS, STRESS ANALYSIS, MODEL MAKING

The conception, design and development of CAMPBELL'S "BLUEBIRD" was a special project undertaken by us.

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IN STEEL BLACK OR MACHINED TO 24 TONS

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MARINE DIESEL ENGINES UP TO 1600 H.P.

300/200 ampere AC/DC type-B
single-operator welding generator set
with concentric dual control

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PowerGrip

PRECISION BELT DRIVES EX STOCK FROM CROFTS

- *Eliminate slip or power loss*
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- *Dispense with tensioning devices*
- *Suitable for slow or high speeds—from inches to over 15,000 feet per minute*
- *Permit high-ratio drives at short centre distances*
- *No lubrication or maintenance necessary*
- *Easy installation with Crofts Taper-Flushbushes*

A typical example of a multiple non-slip "PowerGrip" drive.

AVAILABLE AS STOCK DRIVES—

LIGHT DUTY—$\frac{3}{8}$" PITCH

HEAVY DUTY—$\frac{1}{2}$" PITCH

BOTH UP TO 64 H.P. AT 6,000 R.P.M.

BELT WIDTHS—$\frac{3}{4}$ in., 1 in., $1\frac{1}{2}$ in., 2 in. and 3 in.

Publication 359/L, giving full details, including Power Tables and Notes on Selection free on request.

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POWER TRANSMISSION ENGINEERS

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20 MVA 11kV REACTORS

are included in

KARIBA

hydro-electric scheme at

SALISBURY, KITWE, NORTON, SHERWOOD and BULAWAYO substations.

For shunt compensating . . . Connected to 11kV tertiary windings of transmission transformers and operating on 3 phase, 50 cycle system. O/N type cooling.

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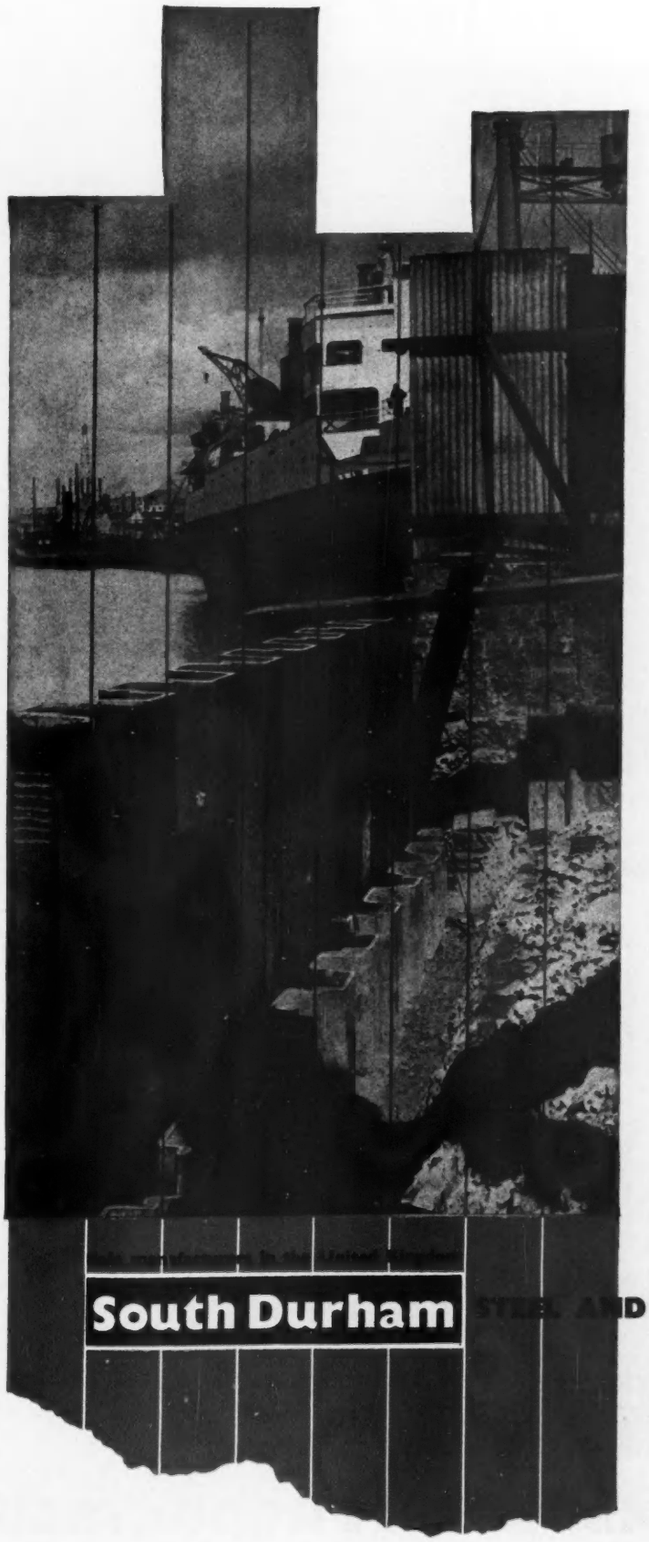

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The TY-ROCK ROD DECK SCREEN is a recent addition to the range of International Combustion equipment for ore handling. The efficiency of this screen has been proved in operation and particularly satisfactory results are being achieved with ores known to be difficult to handle.

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The Speedicut "Chipbreaker" Drill operates at 50% to 400% higher feed rates, with the safety given by chip control. It will therefore drill at least three holes in the time normally taken for two.

We can demonstrate this to you on your own equipment.

There are real savings here, particularly as you also get more holes between regrinds.

Visit us at the International
MACHINE TOOL EXHIBITION
OLYMPIA STAND 312
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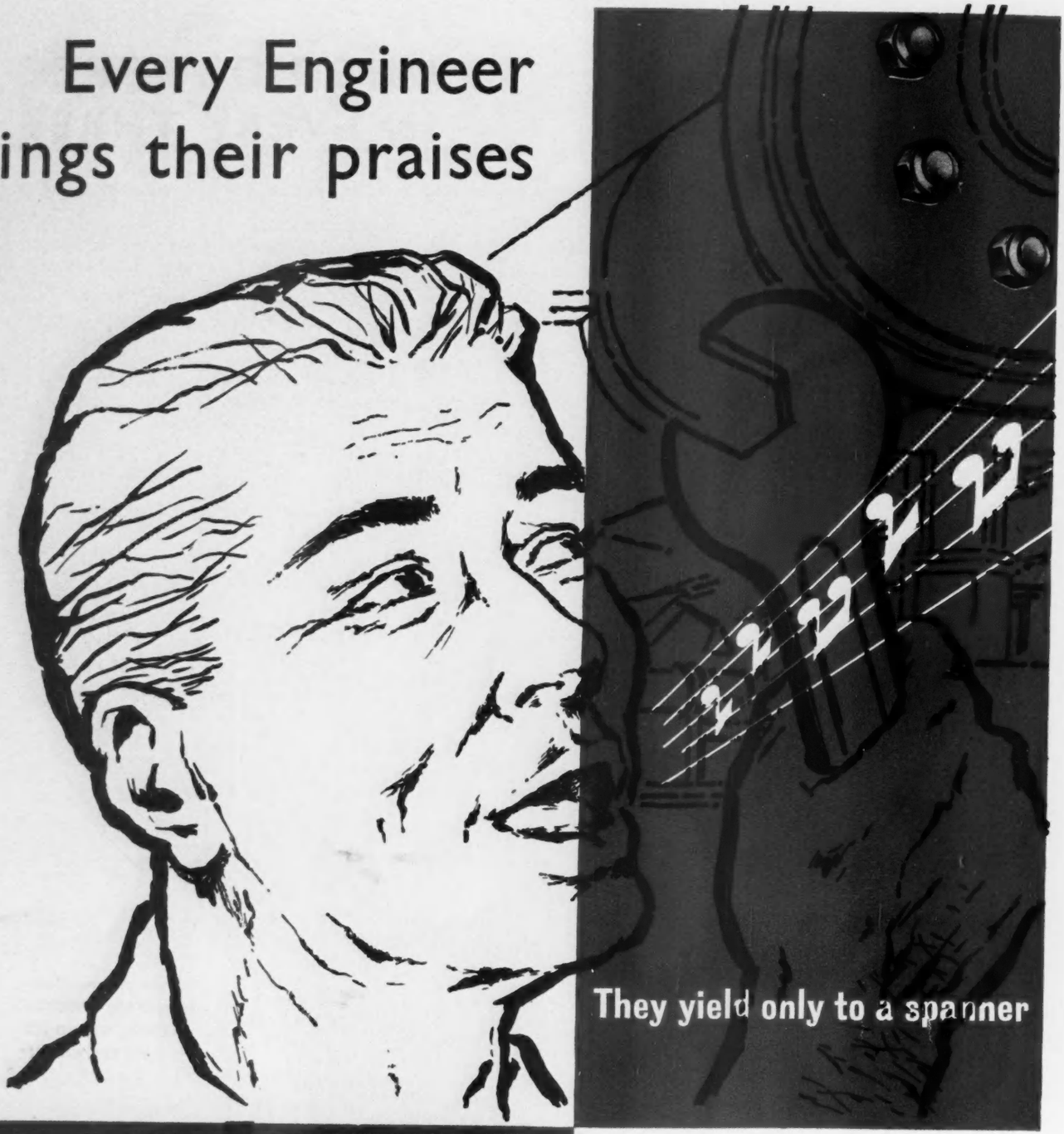
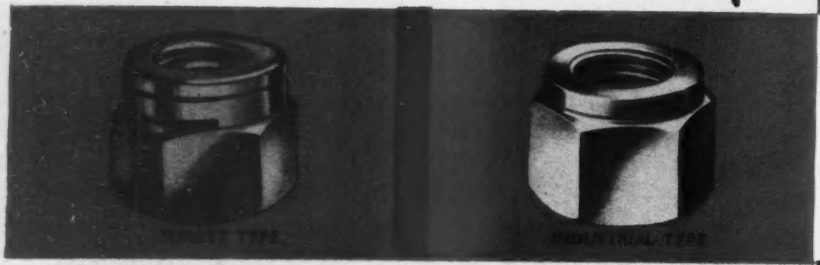
SPEEDICUT

"CHIPBREAKER" DRILLS

FIRTH BROWN TOOLS LTD.,
SPEEDICUT WORKS · CARLISLE STREET EAST · SHEFFIELD 4

Every Engineer sings their praises





Used in many of the best known engineering shops—Philidas self-locking nuts *stay put*. Their unique opposing torque cross-cuts design gives them an unrivalled tenacity that yields only to a spanner. Made without inserts, these one-piece, all-metal nuts completely resist vibration, temperature changes, the presence of oil—and repeated application

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SELF-LOCKING NUTS NEVER LOSE THEIR GRIP

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The quickest way to solve your speed reduction problems is to call in David Brown. Their stock range of RADICON speed reducers covers all reasonable requirements and offers for your choice, 330 combinations of type, size and ratio in standard units from 2¼ to 14—available for despatch within 24 hours.

Behind every 'Radicon' there are 100 years of sound technical and production experience. In front of every 'Radicon' there is a long, long life of hard, hard work.

If your problem is urgent, write for catalogue F.487.20. If it's desperate, please telephone.

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An alliance of engineering specialists in gearing, machine tools, castings, automobiles, and agricultural tractors and machinery.

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THE VICKERS GROUP

VICKERS-ARMSTRONGS (ENGINEERS) LTD.
ELSWICK & SCOTSWOOD WORKS,
NEWCASTLE UPON TYNE
ENGLAND

THE PRESS.

1,200 ton "British Chemig" Press under construction.
(This mass of metal weighs about 165 tons!)
The press is completely automatic in operation & all its parts are made here, including "Dies".

There are two rows of 50 tonne cranes running this way, below & the work is done

Height, about 32 feet above ground, and at least 10 below ground

Five hundred men work in this shop alone when Not so many the works employ ten thousand

Eccentric Gear

Steel casting also made here. 1½ tons

These are Tom Dodds' "Slingers."

This is the long shaft that transmits power from the drive mechanism to the moving parts of the press. It is installed eight feet below the surface.

Tom Dodds, "Slinger" of 17 shop.
An important man indeed. His job is to load, and control all movements of the great cranes.
A great deal depends on his manual skill and judgement. He's a Vickers type all right. His father was a crane driver here, & Tom has a son in the Research dept.

• MUNEO •

The shop is about ¼ mile long and 70 feet high, and there are others like it.

The shop cat, that everybody feeds but nobody owns!

NEXT COMMISSION: AIRCRAFT
• The VANGUARD," Weybridge Works, SURREY.
(Nice + near home?)

Mr. Terence Cuneo has been commissioned by Vickers Limited to produce a series of drawings giving his impressions of the immense resources and production capacities of the Vickers Group. Mr. Cuneo's original pencil sketch and notes for his subject, made on the spot and reproduced here, convey in a particularly vivid manner the size and capabilities of the Elswick shops.

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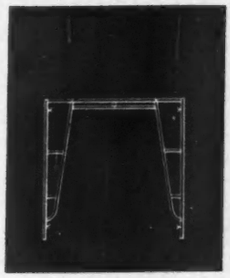

Every engineer who saw this advertisement which we reproduce on the opposite page by the kind permission of Messrs Vickers-Armstrongs must have been impressed, as we ourselves were, by the vigour and realism of Terence Cuneo's drawing For us it held an added interest. Although we supply many large firms (Vickers-Armstrongs among them) with our unit frame works staging we do not always know in exactly what way it will be used, so that it was with particular pleasure that we noted its use in the erection of the Power Press at Vickers-Armstrongs (Engineers) Limited Elswick Works at Newcastle

The illustration emphasises in a rather different manner a point which we have been making for some time—the versatility and suitability of Safway Unit frames both for initial erection and maintenance work for engineering and all industrial applications.

STERLING SAFWAY

Unit Frames for temporary structures. Ships staging Builders access and support Scaffolding.

PROPRIETORS, STERLING FOUNDRY SPECIALTIES LTD. BEDFORD, ALSO LONDON, JARROW, EDINBURGH, AND BRISTOL.

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genius!

An overworked word.
You can turn it over and sit on it.
The world is full of geniuses.

What the world needs today are *practical* geniuses.
Not many of *them* around.

As it happens
A number of engineering practical geniuses
Are assembled at Plowright Brothers

Waiting for you to toss them
An elephant of an engineering problem
Anything from a giant can-opener
To a filter-cake noduliser—
Or (if you prefer) from a Nodobungerator*
To . . . well, a Bungonoderator.

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BROTHERS LIMITED
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Designers and fabricators of almost anything in STEEL.

* *You don't know what a Nodobungerator is, do you?*

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Pressures: L Series up to 15 psi, M Series 11-12 psi
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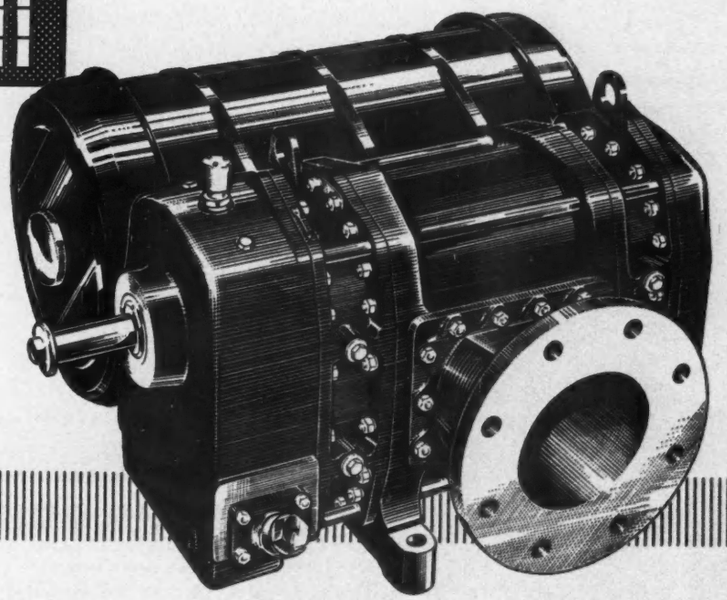

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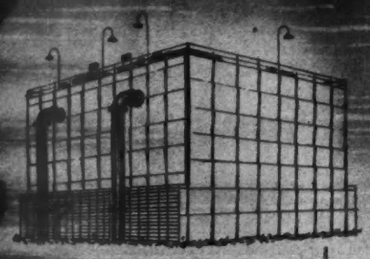
There is more than meets the eye in cooling tower design!



1 ASBESTOS SHEATHING This inherently fireproof material can enhance tower appearance.
2 PARABOLIC FAN STACK Provides maximum fan operating efficiency with maximum structural strength. Increases air volume by velocity pressure recovery and cuts h.p. requirements for a given performance condition.
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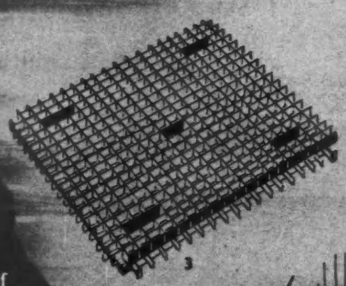
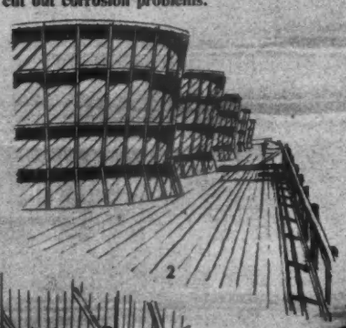
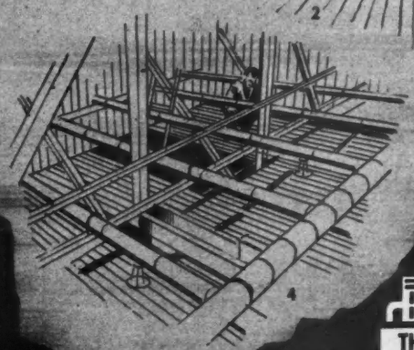
4 WATER DISTRIBUTION Totally enclosed to minimise algae, Timber pipes with porcelain or plastic nozzles cut out corrosion problems.







Their continuous policy of research and development into industrial cooling problems has produced further notable improvements which can now be offered with the Head Wrightson Fluor FP Series of Counterflo Induced Draught Cooling Towers. Tests under all conditions make it possible to give a comprehensive performance guarantee which rigidly defines minimum conditions of thermal operation in every tower supplied.

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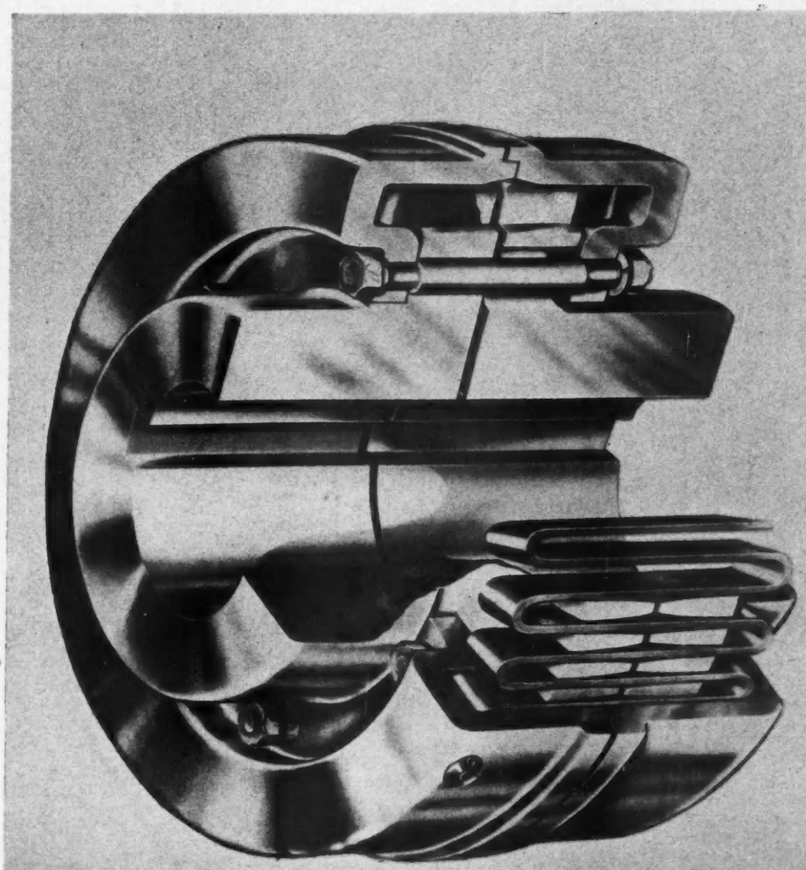

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World famous for outstanding performance and reliability. Made in a wide range of types, all employing the same basic principle of Bibby design.

Special types include: Brakewheel, Cardan Shaft, Turbine, Shear pin, Controlled Torque, Spacer and others.

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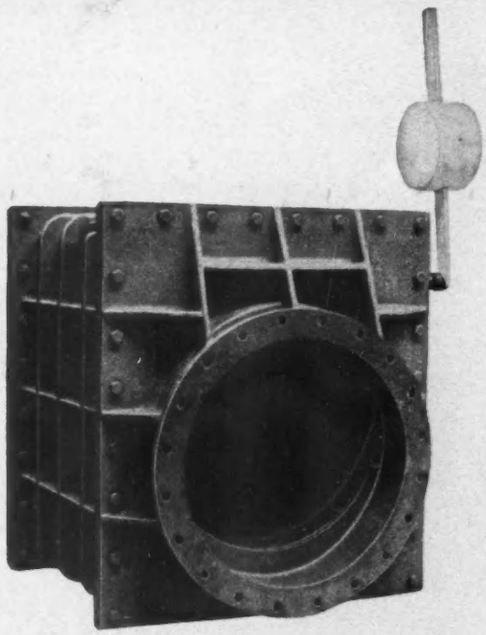

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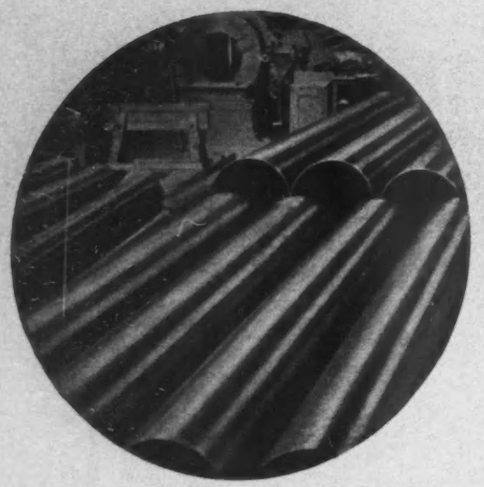
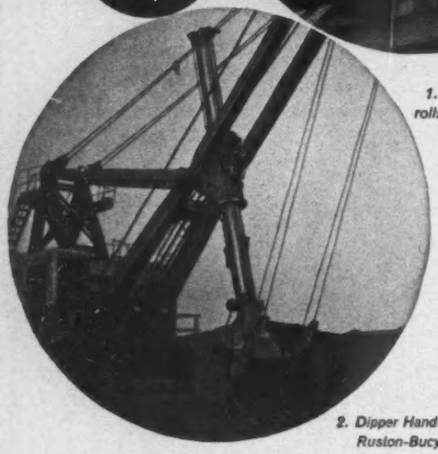


First the tube...

Hundreds of industrial products include a Chesterfield tube in one form or another: products involving seamless steel tubes up to 39" internal diameter, in Carbon, alloy and stainless steels, in quantity production and one-off designs. If you manufacture anything from, with, or in tubes, we'd like to hear from you.

1. *Hard rubber covered dry felt rolls on paper making machines. (With acknowledgements to Millspaugh Ltd)*



2. *Dipper Handles for 200-ton Ruston-Bucyrus Excavators. (With acknowledgements to Ruston-Bucyrus Ltd)*

chesterfield tubes

THE CHESTERFIELD TUBE COMPANY LIMITED,
CHESTERFIELD, ENGLAND *A member of the* TI *group*

CTC66

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10 ton Steam Permanent Way Crane. Metre Gauge. Duty: 10 tons at 16 ft. radius propped; 5 tons at 14 ft. radius free.

3 Motor, electrically operated Fixed Wharf Crane. Duty: 15 tons at 22 ft. radius.

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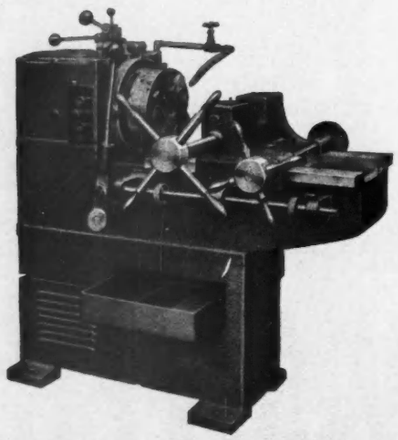
have been designed for production screwing of all classes of bolt and pipe work and very high rates of output consistent with good quality threads can easily be maintained.



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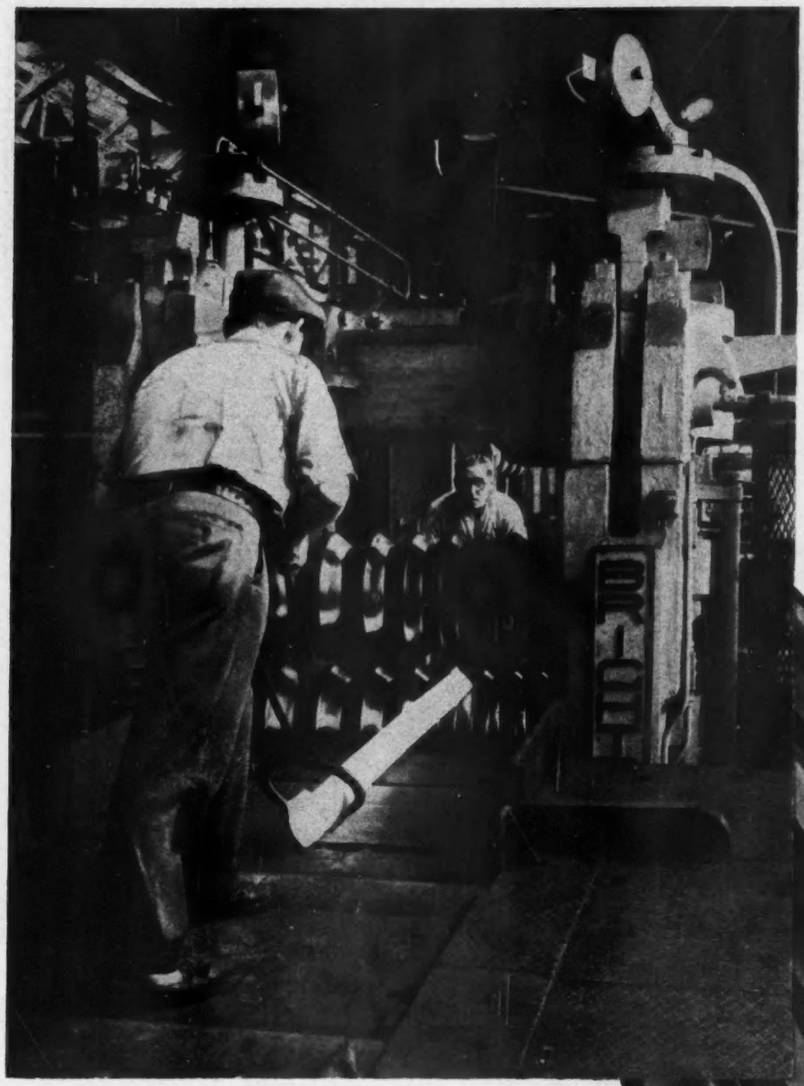

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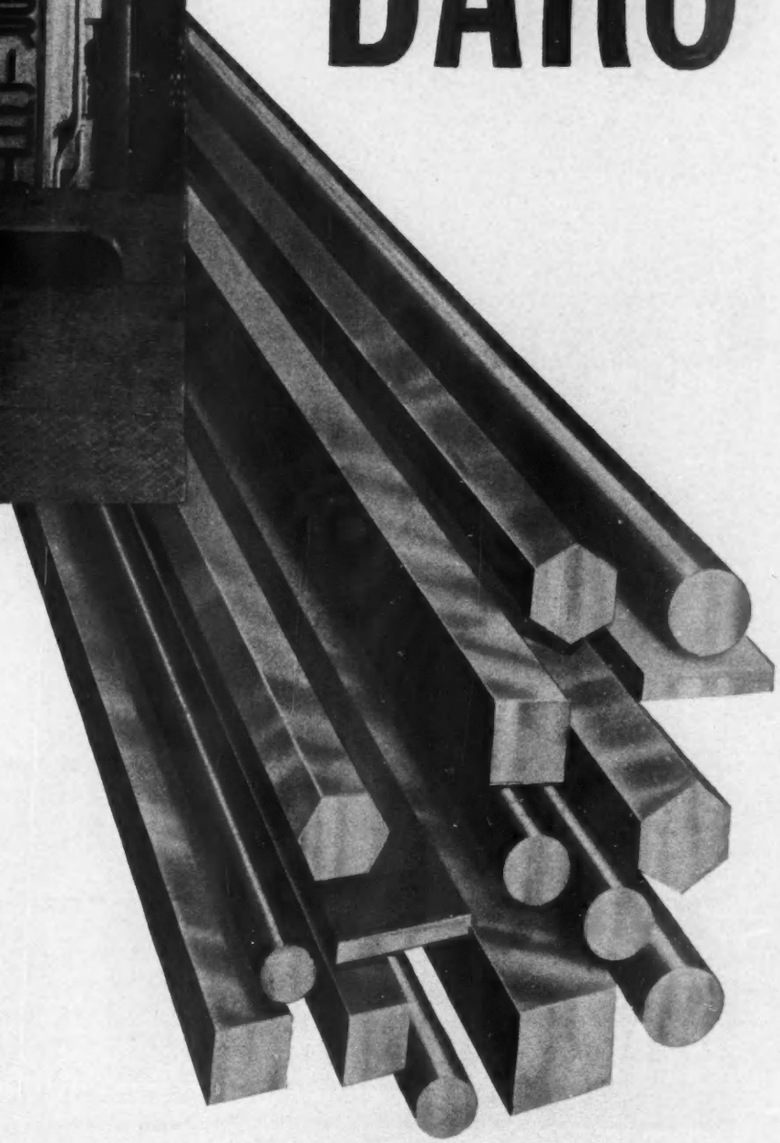

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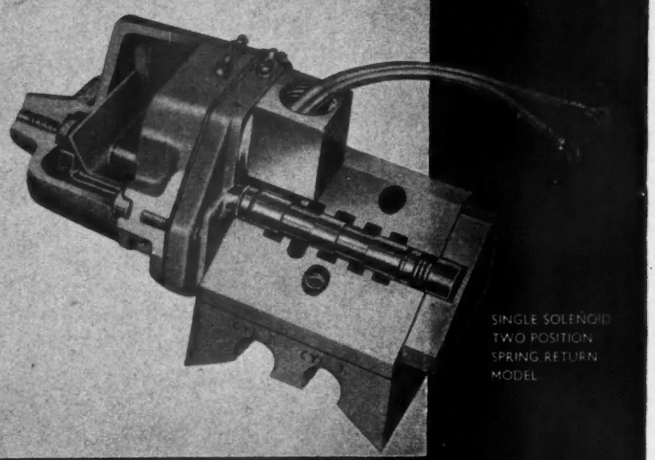

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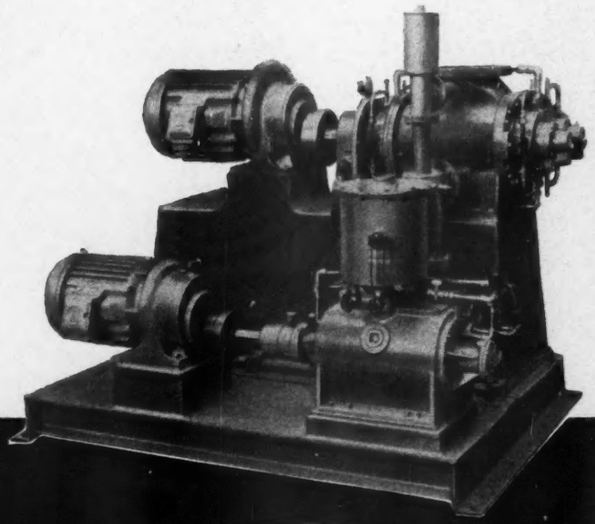

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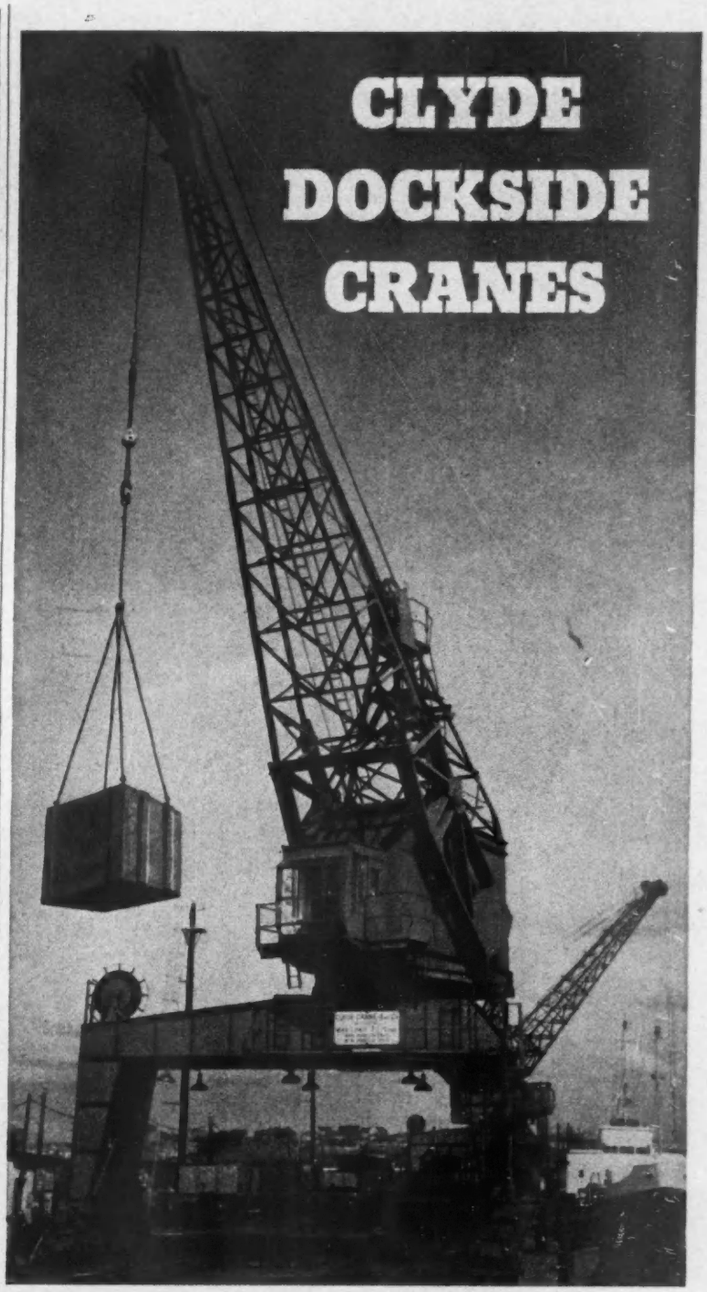

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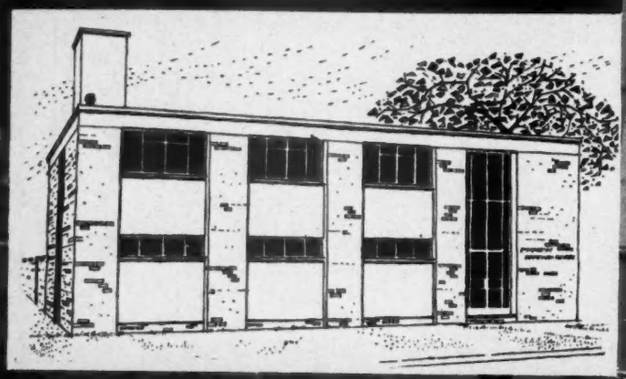

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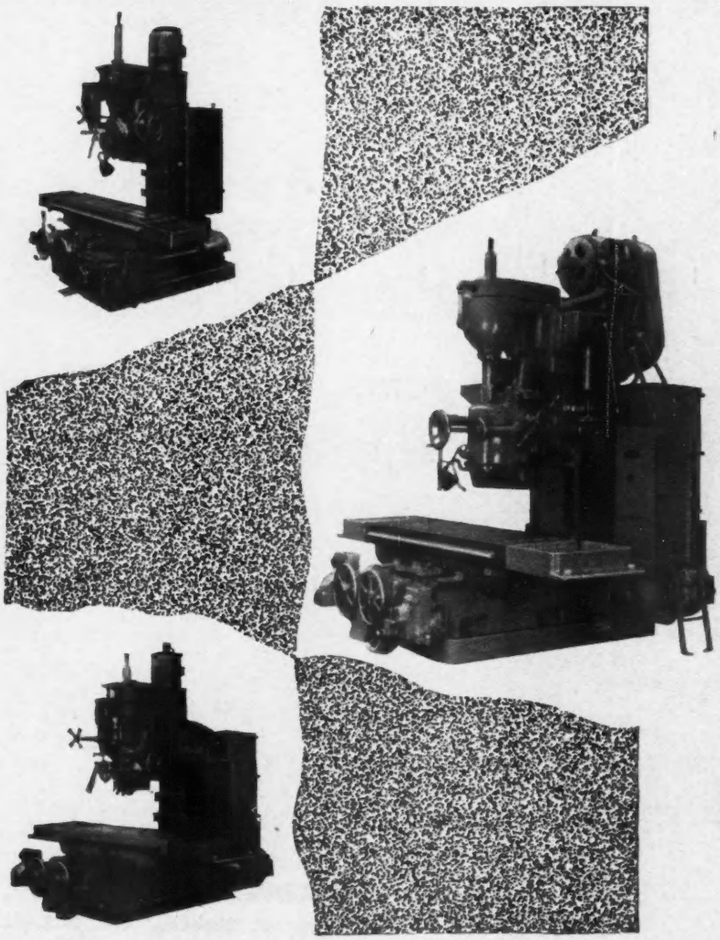

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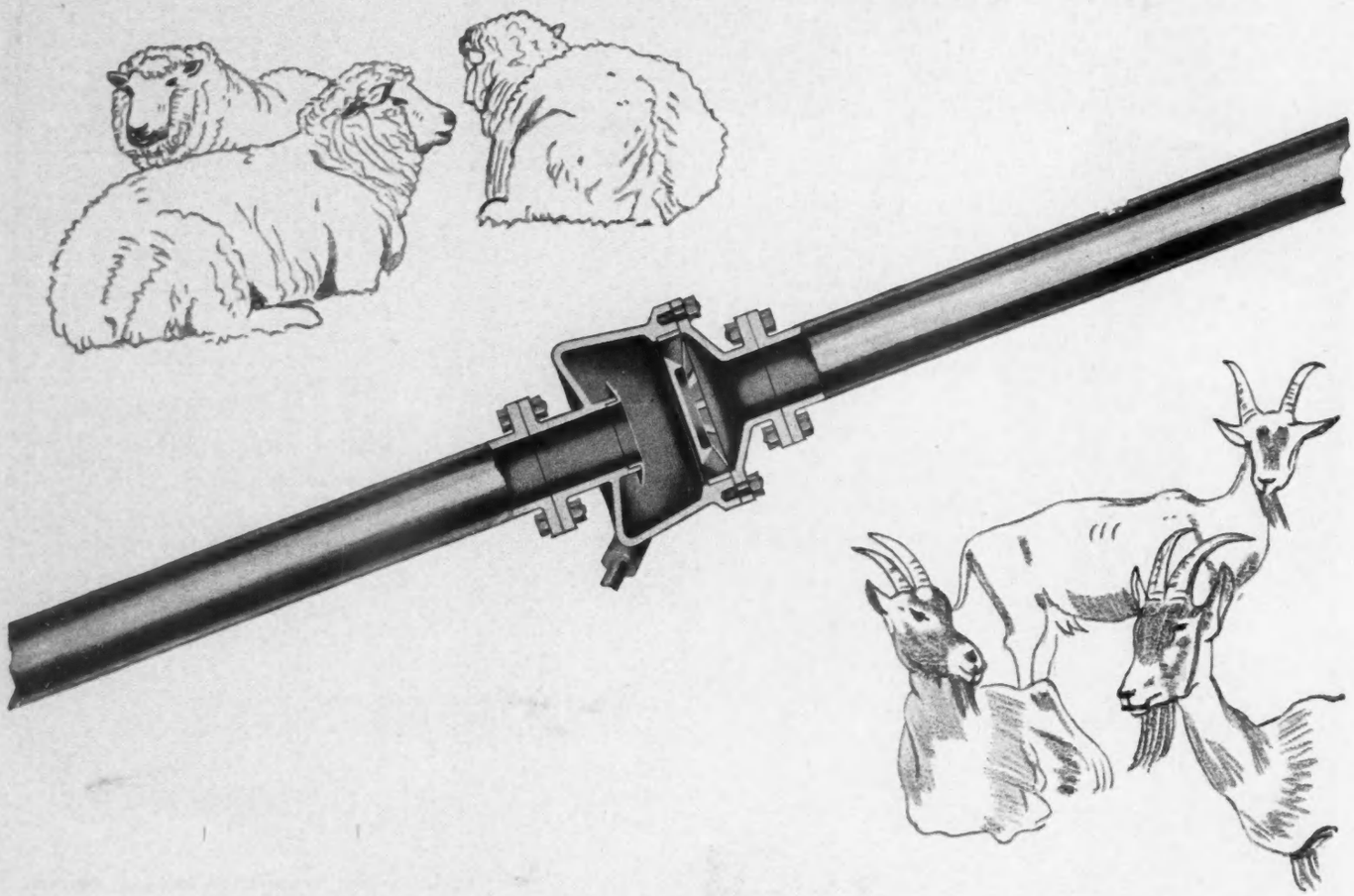

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ENGINEERING Impact

of Mr. Khrushchev and Flight Beyond Mach 2

THE shock wave of the Summit collapse may not have stopped the flow of the tide towards more relaxed attitudes and more frequent meetings.

What it has quite certainly done is to revive some hopes in Washington that have direct significance for the United Kingdom aviation industry. The attempted change is not one connected with missile hardware or the big rockets.

It lies in the possibly much more relevant field of aircraft development. For those in the aviation industry of the United States the most gloom creating action of President Eisenhower's administration last year was the scaling down of the plans to produce numbers of the advanced bomber capable of speeds above Mach 2.

Once this decision had been taken the enormously expensive problems of heat dissemination, take-off and landing, and flight control of aircraft able to cross the Atlantic in two hours were back on the table of the private aviation companies—without the gentle cushioning of Pentagon defence contracts.

The significance of this decision for Hawker Siddeley and the British Aircraft Company was plain enough.

The fact that the U2 incident arose from only one of many United States flights across Russia has given the Air Force generals in Washington the chance to return to the attack on behalf of prolonging the life of the bomber plane. Resuscitate our advanced bomber is their committee room cry.

If the call succeeds, the multi-billion dollar development schemes will be approved and once again the United States Air Force will "iron out the bugs" of a major new aircraft before the US air industry puts it on sale to the world.

Neither the British aviation industry nor the UK Government can sway the Pentagon decision. But while there is indecision there a bold decision here, especially now that Blue Streak has fallen flat, could not only put us in the race but could secure the inside track.

Machine Tools and Research

A cooperative research council is to be formed by the Machine Tool Trades Association working in association with the Department of Scientific and Industrial Research. This was announced by Mr. E. W. Field in his presidential address at the annual general meeting of the association. Specific proposals concerning this council are to be made at a further meeting of the MTTA.

This step follows the realisation that the products of some British machine tool manufacturers are "falling short by comparison with their opposite number abroad."

The association realises the need for the further education of those within the machine tool industry at all levels. An education officer is to be appointed, whose duties will include a survey of the design teams at present operating within the industry on both a quantitative and a qualitative basis. He will also be concerned with visiting members of the association, local education authorities and principals of technical colleges to bring about that closer understanding of each other's problems which must be the forerunner of any really adequate flow of trained personnel to the industry.

While still dealing with the subjects of education and research, Mr. Field said "I would, therefore, leave you with the exhortation that these interlinked subjects of education and research must receive far greater attention in the immediate future than they have done in the past."

Aero Techniques in Land Vehicles

Donald Campbell's new Bluebird, although very much a one-purpose car, provides us with another example of the use of aero techniques in the design of land vehicles. The Ford Motor Company's projected Levacar goes a stage further; it even looks like an aircraft except that it has no wings; and it runs on "levapads" instead of wheels. The levapads emit compressed air thus forming a thin air film between them and the track on which the Levacar "runs."

In the Bluebird the body shape is governed principally by aerodynamic considerations, and propulsion is by a modified gas turbine aero-engine. Now it has just been decided that the "Didas" telemetered instrument system developed by Sir W. G. Armstrong Whitworth (Aircraft) for sending information back to the ground from rockets will be used on Bluebird. Its function on the car will be to telemeter critical engine and frame conditions to technicians during actual running, instead of their having to wait until the end of each run to study photographs of the instrument readings. By means of a radio link it will thus be possible to warn Campbell if dangerous conditions arise.

At the joint symposium of the Aluminium Development Association and the Institution of Locomotive Engineers in London last Friday on "The Use of Aluminium in Railway Rolling Stock," some importance was laid on the force-matrix method of structural analysis. This lends itself particularly well to the use of an electronic digital computer; indeed, it is impractical without one, and together they provide the designer with a much handier means of solving a complex structure than hitherto. As might be expected, aircraft fuselage design with its complex stresses plus the emphasis on the saving of weight, was the first serious commercial application and so it has tended to become associated with aeronautics. With the increasing use of aluminium for railway coaches and the consequent aim to minimise waste of material, the use of the force-matrix system is now developing in this field too. No doubt as time goes on its application will become more widespread, and the similar conditions in large passenger and goods road vehicles provide obvious scope.

The action of one branch of engineering on another may bring forth entirely new concepts of design.

of Taking Industry's Research to Teddington

A research association cannot live by research alone. The results of its work and the technical knowledge and experience of its staff must be brought to bear on the practical problems of the manufacturers who support it. This was stated in the annual report of the Research Council of the Department of Scientific and Industrial Research, issued last week.

The statement refers in particular to the 50 research associations supported by the DSIR and says that funds are available for a scheme to assist in developing better methods of disseminating research results. The DSIR will make a grant of up to two thirds of the estimated cost of any suitable project submitted by an association. Fourteen applications have already been made under this scheme, with proposals such as mobile laboratories, display units, demonstrations at factories, training courses and advisory service on design.

The problem of communicating research data, both widely and effectively, is not peculiar to the research associations. The difficulty is just as great at the National Physical Laboratory.

The director of NPL, Dr. G. Sutherland, F.R.S., has outlined a scheme which is intended to assist in the job of communication and to ease the ever present problem of obtaining experienced research engineers.

Simplicity itself, the idea is that when a particular organisation wishes to use the facilities of NPL on a research matter, it makes available one or more of its research staff who can then team up with the NPL workers at Teddington until the project reaches a satisfactory conclusion. In addition to helping the NPL staff problem, this scheme has the double advantage of vitalising the research effort and improving the liaison with industry.

A Machine that Says "Can Do Better"

Who can decide whether engineering's greatest contribution to life is the opening up of new fields of achievement or the removal of repetitious drudgery?

The executive flying six miles above the Atlantic on his way from lunch at London Airport to an after lunch meeting in New York may hold the opposite view to the housewife who perches on a kitchen chair reading while a machine works its way through the family laundry.

The two can be combined. By the electronic teaching machine now to be made in Britain the drudgery imposed on the teacher of repeating facts and figures year after year is lifted. Early applications of the Auto-Tutor, which was developed in the United States, are likely to be in industry. The advantage of putting forward information with the active participation of the pupil, incorrect assimilation being corrected and the next stage only then being taken up, is of obvious application to any large plant where numbers of skilled and semi-skilled operatives are frequently having to change their routines.

The use of the US Industries' teaching machine in the schools would mean that the teacher would enjoy release from the routine imparting of information and correcting test results. He or she would have the opportunity to study more intensively, and more adequately to widen the horizons and explain the background for his pupils. The brake on all this, apart from the reaction of the teachers, is financial. The Auto-Tutor's cost varies between £1,000 and £4,000.

Time to Think

The pace of change, in which engineers introduce workable automatic devices into the classroom, is not going to stop at that. The electronics industry will increasingly find itself confronted with opportunities to mechanise the routine, at least in theory, leaving more time for the exercise of creative faculties.

A useful application of the principle of the teaching machine lies in the direction of road safety. A new driver who had worked his way through a prepared programme on the Auto-Tutor, being corrected and shown how his mistakes arose, being congratulated and set the next task when things were going well, could be much more accurately evaluated by the machine than by the most conscientious of human examiners.

Drudgery at work and drudgery in the home have been vastly reduced in many parts of a world which has at the same time become uncertain of its future in a uniquely unpleasant degree. If the teaching machine ever becomes generally used it could reduce the time taken in absorbing facts, leaving time for reflection and the encouragement of the imagination.

Which would have incalculable effects.

and of Royal Interest

There are so many trade and technical journals today that only a small proportion of them could be represented at the reception for Commonwealth journalists which the Queen and the Duke of Edinburgh attended this week. Although there are 360 trade and technical journals whose publishers are members of the Periodical Proprietors Association, only 12 "working journalists" from these papers were invited to the home of Lord and Lady Astor of Hever, overlooking the Mall. ENGINEERING was one of the few so honoured.

The big-circulation and national papers do most of the reporting of royal occasions and are therefore responsible, more than any other medium, for the pleasure we all share in thinkingwe "know" the Royal Family. But perhaps on another occasion there can be a stronger representation of the technical press. There are few national newspapers but many technical papers. In terms of publicity overseas, the technical press must have a far greater readership than the nationals, and it has a unique job to do for the nation.

The Queen would be quick to appreciate such a factor. As she spoke to the journalists at the reception, she put the kind of searching questions that only an inquiring mind would formulate.

Your Chromium Will Soon Last Longer

Positive action is being taken to improve standards of chromium plating. Our labelling scheme is years ahead of everybody but we still ought to take more notice of what the Americans are doing technically.

Too much chromium plating in the United Kingdom is of bad quality. Unfortunately, no one is particularly to blame for this. But we now have spare capacity for making nickel in the free world and the one certain way out of difficulty is to put more nickel under the chromium. Hence it is gratifying that action has been taken to put into words what we've known for a long time: the old standards for chromium plating were inadequate, especially regarding thickness of nickel underplate.

Three organisations have teamed together to inform us of what we can do to expect good performance from chromium, namely British Standards, British Non-Ferrous Metals Research Association and the Mond Nickel Company Limited. If you have seen advertisements and read about plating, you've been subject to one of the nine points by which these organisations, especially Mond, are attacking the problem. For diagnosis of which angle you have suffered from, see the box.

First step was launching of the project, taken six months ago. British Standards Institution prepared and issued a new criterion for plating, BS 1224:1959. BNFMRA developed a new measuring instrument to test non-destructively the thickness of the plate. And as one of the world's major suppliers of nickel, Mond felt that it was possible to inform the public when the plating was to specification. This would be done by applying labels to the finished jobs.

The new British Standard is a revision of an earlier specification. The most important change in the new edition is a provision for thicker coatings of nickel on zinc-based alloy die-castings. A second change is the inclusion of new, more stringent, laboratory tests which plated products must be able to pass if compliance with the standard is claimed for them. Two of these tests ensure that chromium plating will stand up to corrosion.

NINE POINTS OF ATTACK. . . .

Launch scheme: Press conference outlining British Standard, BNFMRA thickness gauge and Mond labelling scheme

Campaign to platers: Advertisements in trade press and direct mail

Get idea over to top management using plated products: Advertisements in national journals

Enlist support of executives who specify plate: Advertisements in trade press

Explain labelling to public: Television and national advertising

Inform trade and public: Exhibitions and conferences in industrial centres. Two films to be made

Disseminate knowledge to platers, manufacturers and designers: Distribution of technical literature

Explain labelling to distributors

Promote understanding between designers and platers: Campaign under theme "Good Plating Begins on the Drawing Board"

In all, nine tests are prescribed in the standard. They include the tests for corrosion resistance in which plating is exposed to the attack of sulphur dioxide, or acetic acid and salt; tests to check the thickness of both nickel and chromium surfaces deposited on an article; and tests to ensure that the plated finish will not easily peel away.

Identification of products complying with the standard will be made possible by a labelling scheme which, in the first instance, is being operated by Mond Nickel. This company, working in collaboration with British Standards Institution, will supply labels to platers and manufacturers of plated products who must undertake to apply these labels only to plating which complies with BS 1224.

The new standard calls for three grades of plating, depending on the use to which plated products are put. The top grade of plating will bear a red label; that to be used indoors, sometimes in steamy kitchens and bathrooms or on products stored in damp cupboards, should bear a blue label. Where less arduous conditions are involved the green for mild category will be quite sufficient. Each label will announce that the nickel-chromium plate conforms to British Standard 1224:1959.

Granted the most satisfactory standards in the world, there is no reason why they should be complied with; it has always been possible to specify better or worse coatings than the standard—unfortunately, worse in most cases. Cooperation, education and confidence are needed. Mond's actions are designed to increase sales of nickel; accept the fact, but don't let it trouble you. If you know of cases of bad chromium, then applaud their actions in putting into practice the obvious steps needed to make the scheme a success.

Mond's nine points of attack are designed to stimulate designers, buyers, and manufacturers into being aware of what can happen if they do not specify the right quality of plating for the job. So far the company report that cooperation is gratifying and that high standards of honesty and sincerity have been uncovered. But there is a plea to the design engineer in particular: please realise that the place to specify what plate should be used is at the drawing board. If it doesn't go on then, there is little hope that any later hand will specify anything except the least expensive.

How does the plater fare? He is being asked to increase his thicknesses. Does this mean less money? Not at all; there is no indication that the consumer is not prepared to pay more for a better plate.

What of the new processes, like duplex nickel plating? Why not a fourth grade of corrosion resistance for the car trim which is left out all winter, and should specifications include duplex? The answer is that another grade is certainly needed, but that there are still doubts about the new duplex processes. It would be worth straightening out what is meant by a fair corrosion test, and waiting for more experience before laying down specifications for the last grade. Still, industry is busy on evaluating what could be used for the severest corrosion. If you're interested further, read the other sections on these pages.

Ideas Must Be Straightened Out On Testing

"Do not take accelerated corrosion tests as the be-all and end-all." This piece of vernacular from someone in the plating world, sums up the current British attitude to accelerated tests.

Even granted an acceptable corrosive medium it still remains to assess the amount of "corrosion." One way of assessing the degree of corrosion is the adoption of a rating number, to indicate the amount of breakdown, which is arrived at by means of the formula

$$R = 3(2 - \log \Sigma f \times a)$$

In this formula a is the area on test panel appropriate to a particular defect and f is the weighting factor ascribed to each individual type of defect as follows: pinhole rusting, 1·0; light iridescent stain, 0·01; crater rusting, 4·0; blisters, 2·0; peeling and flaking, 4·0; light surface pits, 0·01; crowsfeet cracking and moderate to heavy surface pitting, 0·25; dark stain, 0·10. Thus, a rating of 1 corresponds to 50 per cent of area marred by surface defects and 10 to 0·05 per cent. Weighting factors may differ from one investigator to another and hence different results are obtained.

Plated coating on steel panels	Performance ratings				
	9 mths Detroit roof (static)	20 hr Corrod-kote	24 hr CASS	One winter's service on bumper of car	
				Detroit	Chicago
0·001 in bright Ni 0·00001 in Cr	4·5	6·0	5·0	8·4	9·1
0·001 in bright Ni 0·00003 in Cr (HRHT)	6·0	8·0	7·0	3·9	5·2
0·001 in 80/20 duplex Ni 0·00001 in Cr	5·5	9·0	9·5	8·4	9·0
0·0004 in Cu+ 0·0008 in bright Ni 0·00003 in Cr (HRHT)	9·3	9·4	6·0	8·8	9·4

Simpler schemes, based on general appearance and on rating according to photographic standards are now sometimes used. Investigators also differ as to whether test panels should be cleaned during the period of exposure.

Among the accelerated tests, the Corrodkote is a popular American one. In this a slurry is applied to the plated surface similar to road mud. After drying for one hour, the coated article is placed in a humidity cabinet, under non-condensing conditions for 20 hours.

The copper-accelerated salt spray test, or CASS test, was developed by the ASTM in 1955 and consists of modifying the well known salt spray test by addition of acetic acid and a copper salt.

The electrographic test has recently become popular, because it serves to show up the crack pattern or pore distribution in chromium layers.

The sulphur dioxide test originated in the United Kingdom. As practised in the UK, it is carried out in a water sealed cabinet in a moist but not condensing atmosphere containing 0·5 to 2 per cent of sulphur dioxide by volume. In support of this test, it is pointed out that the main corrosive component of industrial atmospheres is sulphurous gas.

Differences in behaviour of similar coatings have been investigated by Saltonstall and Millage who examined four different coatings on steel. The table shows the ratings; there are considerable differences.

Now let three suppliers of plating chemicals state their views when these tests are used to evaluate new coatings like duplex nickel. Electrochemical Engineering say "Accelerated corrosion tests give a quite misleadingly optimistic picture of improvement in service behaviour which can be obtained through the use of the duplex system in comparison with the all bright nickel." This is echoed by Canning: "Advan-

tages shown in accelerated tests for duplex over the same thickness of bright nickel are greater than those found in outdoor exposure tests in an industrial atmosphere." Harshaw are not particularly impressed by the sulphur dioxide test. "It is an excellent test for determining the crack pattern of the chromium layer. The atmosphere, however, causes production of nickel sulphide and the nickel deposit is no longer sulphur-free. Industrial areas always contain sulphur dioxide, but the fact remains that you and I walk about regularly in industrial atmospheres, but neither would care to put his head into a sulphur dioxide chamber. We much prefer the results from the Corrodkote and CASS tests and this view is shared by the whole of the American industry and by certain interests on the Continent."

Duplex Nickel Undercoats for Severe Service

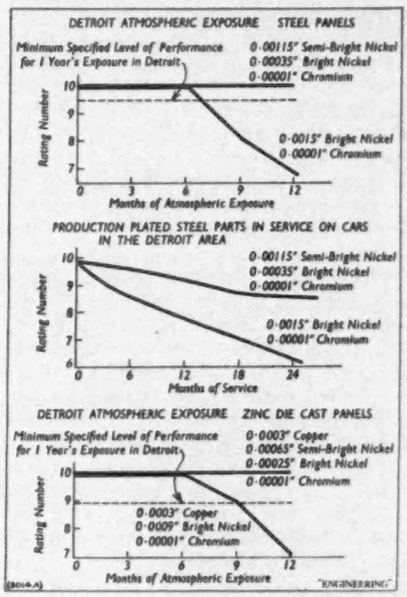
Duplex nickel is one of the much-talked-about plating processes which could improve performance of chromium under severe conditions. The process was developed initially by Harshaw in the USA. Four systems available in the United Kingdom are outlined in the table.

Feelings are mixed in this country. For instance, BNF comment that much of the evidence on which changes in plating practice in the USA have been made relies on accelerated corrosion tests, the validity of which still has to be confirmed in relation to conditions in this country.

Harshaw's semibright or Perflow process was introduced in 1945 for car bumpers. During the period 1946 to 1953, several companies in the USA used bright nickel over semibright to obtain better appearance without nickel buffing or with less steel preparation. Among items plated in this manner were many non-standard car accessories and small stampings not amenable to polishing of the basis metal. Around 1953 a bright nickel bath was developed which was compatible with the semibright, and during the same year the first large bumper installation was started with duplex.

Thus duplex coatings arose to avoid buffing, but it was soon realised that corrosion resistance was also outstanding. Corrosion by pitting has been shown to stop at the interface between the nickel layers, even, according to recent work, in atmospheric exposure. This has been attributed to the radically different structures of the two deposits. Harshaw do not believe this is the explanation since columnar semibright deposits can be produced which when covered with a laminar bright nickel do not improve the quality of the coating. They stick to the theory that sulphur-free semibright nickel is less anodic to chromium than bright. In the USA they have immersed three such deposits joined electrically in an acetic acid salt spray solution and in a solution made by diluting the Corrodkote slurry. The weight loss of the bright nickel was greatest in both solutions. Bright nickel dissolved at about 40 times the rate of the semibright.

Chrysler Corporation, of Detroit, who have been using duplex nickel on car bumpers, steel and zinc die cast decorative parts for a number of years, have evaluated all the nickel plating processes as undercoat for chromium. Three of their test results, as reported in an SAE paper, are illustrated. These speak for themselves. It still remains for us, however, to decide what is relevant to the United Kingdom.



Duplex Processes Available in United Kingdom

	Harshaw Chemicals		Efco-Udylite		Canning		Albright and Wilson	
Baths (top coat, right) ..	Perflow	Perglow	NCS or N2CS	No. 66	High speed Nivo	Super Gleamax, BQ840, BQ Super BQ860	Plusbrite SBSF	Plusbrite
Thickness, per cent of total nickel	50–75		60–80		50–70 60 optimum		50–65	
Minimum thickness, in ..		0·00025				0·0003		0·00025
Bath operating characteristics, pH	3·5–4·2	3·3–4·4	3·5–4·5	3·0–4·0	4·2–4·8	3·9–4·5 (4·2–5·0 for BQ super)	3·9–4·3	3·0–4·5
Temperature, °C ..	49–56	52–72	46–59	46–59	43–49	52–57	42–65	25–60
Cathode CD, amp. per sq. ft	20–100 (to 150 with air)	20–100 (to 150 with air)	20–50	20–100	20–40	30–75 (to 140 with BQ860)	30–100 (or higher)	5–70 (to 120 with air)
Agitation	Mech. or air	Mech. or air	Mech. or air	Vigorous air	Air	Mech. or air	Air	Mech. or air
Purification	Add formaldehyde to overcome reduction products. Batch for organics	Batch treatment through carbon	NCS: batch treat through carbon N2CS: contin. through carbon	Continuous filtration through carbon	Continuous filtration through carbon	Batch treatment with carbon	Continuous through carbon without loss of brighteners	Continuous through carbon without loss of brighteners
Compatability of baths ..	Compatible. Rinse only for zinc castings which trap liquor		Compatible. Rinse to remove solid residues. Also for zinc castings which trap liquor		Compatible. No rinse, but avoid work drying between baths		Compatible Rinse not normally required	
Adhesion of nickel to nickel to chromium	Good, no trouble or precautions		Be careful to avoid metallic (copper and lead) impurities in baths which lower adhesion of nickel to nickel		Adhesion and colour of chromium good. No special precautions when chroming		Adhesion of nickel to nickel and nickel to chromium good	
Levelling	Good levelling in both baths		NCS and No. 66 are good, N2CS is not so good		Good levelling in both baths		Good levelling in both baths	

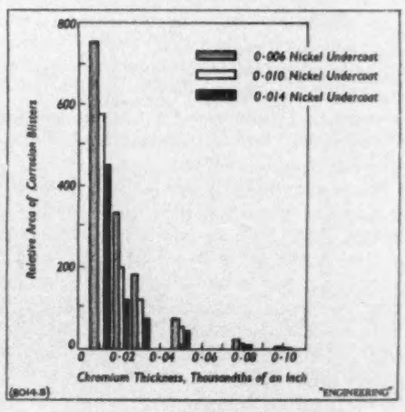
Thicker and Crack-Free Chromium

Another approach to improving performance of chromium plating is to increase thickness of the chromium. Metal and Thermit Corporation in the USA reckon that thickness for thickness nickel is equivalent to only one-fourteenth the corrosion resistance of chromium. Mond agree with this but say on the other hand that it is doubtful whether it will ever be possible to plate chromium in sufficient thicknesses to give good corrosion protection without eventual cracking of the deposit.

The beneficial effect of thicker, crack-free deposits of chromium has been confirmed by work in the United Kingdom by BNF as illustrated. Increases in thickness of chromium to 0·00002 to 0·00003 in plated in a crack-free condition from a high temperature, high ratio solution conferred improvement on the performance of plated die castings under the severe conditions of static roof-top exposure in London.

Duplex chromium is another feasible process, developed especially by Metal and Thermit in the USA, but full evaluation by service tests is not yet complete. Although thick crack-free chromium or duplex chromium offer some advantages, there are drawbacks to use in production. First, chromium coatings which are crack-free when deposited may, after some time, crack during storage or in service. Even if the cracks are fine, this crazing will in time cause dulling of the surface and possibly flaking of the chromium.

Finally, by using high temperature, high ratio solutions, the throwing power of chromium can be improved, but it is still extremely poor and in commercial plating of complicated shapes it will be difficult to ensure uniform deposits over a whole surface. It is always important, therefore, to apply the full thickness of nickel undercoat.



Plain Words

By Capricorn

MARKETING men appear to believe that if I want to buy a set of steak knives, my first thought will be to run to the nearest grocer and buy five boxes of soap powder, tear off the box tops, sweep up the powder, fill in a form, get a postal order for 11*s*, put box tops, postal order and form into an envelope, empty wallet, desk drawer and all pockets in search of a stamp, run down to buy a stamp, post the letter and wait five weeks for the knives.

Perhaps I am different and soap salesmanship is directed at people with orderly minds who have special little places where they keep things like envelopes and stamps and pens that work; orderly people who know five weeks in advance that they are going to invite someone important, and that steak will be served for dinner. With me it does not work out that way.

But if the majority of people prefer to buy something else in order to get what they want, it is very surprising that this—presumably successful—marketing stunt is not extended to anything beyond soap and cereals. The only thing these products appear to have in common is the flat cardboard box in which they are sold. One can imagine how the sales manager's critical eye must have fallen on the box top, wedged between two well utilised surfaces bearing suitably motivating designs in bright colours approved by psychologists, and wondering what to do next. Then it must have hit him: there is still room at the top.

Well, perhaps there is room elsewhere, too. After all, people who buy soap and cereals are not very different from people who buy cars, and houses, and cranes, and hydro-electric power stations. What if aircraft manufacturers were to include a 60 ft yawl with each consignment of jet aircraft? Or seek to influence the buyer's judgment by dispatching free-of-charge a set of nose-wheel covers?

Better still, executive desk-sets could be offered for fifty sack-corners from a shipment of granulated pvc and a small payment in cash. One hundred ball-bearing wrappers might be worth 10 ft of neon tubing, twisted to the shape of your firm's initials. (Please tick letters desired on enclosed form.) A frugal purchasing officer might be driven to ordering a ten-year supply of soldering flux by the prospect of receiving a tea dispenser for his canteen for next to nothing. Businessmen are only human and the list of possibilities is endless.

If anyone thinks of starting such a scheme, I ought to warn him of a quirk of human nature that could upset his plans. A man will be as delighted as a child at a party if he is given, say, a set of spoons to commemorate a firm's anniversary (the present is personal and he can take it home to his wife), but if the present is to his firm he may be quite uninterested.

We're selfish brutes.

Letters to the Editor

Developments in Wales

SIR, As chief executive of the Development Corporation for Wales, I am grateful to you and your correspondent, Mr. H. J. Novy, for the excellent review of "Engineering Growth in Wales" (ENGNG., 13 May '60, p. 646).

This article provides undoubted evidence of the industrial revolution which has occurred in the Principality during recent years and which is increasingly justifying the people of Wales in shedding "their memories of the past" to which Mr. Novy refers.

It must be remembered that, prior to the Second World War, manufacturing industry in Wales was of negligible proportions; employment in such industry now exceeds that remaining in the stream-lined basic industries of coal and steel. This in itself is a most significant factor; real diversification has been achieved. But, because of the former lack of manufacturing industry within Wales, the diversification has necessarily come from without her borders.

Those concerned with the location of industry will, I feel sure, agree that human, as well as economic, considerations play a significant part. Every inquiring industrialist comes forward with his predilections—even prejudices—which it is impossible to anticipate. While, therefore, I agree with Mr. Novy that, in the ideal world, "direction," "initiative and courage" are valuable assets, the sphere of industrial location is one in which it is frequently not practicable to meet the industrialists' requirements from "off the rack." The operation of these human factors is not always appreciated by those who seek to draw up a blue-print for industrial location.

Yours faithfully,
GERALD S. F. RITSON,
Chief Executive.

Development Corporation for Wales,
15 Park Place, Cardiff.
23 May, 1960.

Scottish Students Go South

SIR, I am delighted to learn that Mr. D. A. S. MacLellan has studied my letter on the student situation in Scotland (ENGNG., 15 April '60, p. 504) so thoroughly; although I do regret that he did not give the same weighty consideration to the article which prompted it.

Mr. MacLellan, in his letter on "Apprentice Pay in Scotland," accuses me of basing my criticism on half-truths (20 May, '60, p. 680). This charge I must repudiate entirely. The facts as submitted by Mr. H. J. Novy in his article "Engineering Growth on Clydeside" (1 April, p. 446) are, that in 1955, 395 manufacturing firms employing 89,000 workers, employed no more than 204 engineering graduates; that in the shipbuilding ndustry, 13 firms employing 21,000 operatives included only 18 graduates on their staffs; and that "management decay set in and brought in its train a disrespect and indiscipline, in fact a vote of no-confidence, on the part of the managed." An outrageous situation!

If Mr. MacLellan disbelieves these statements surely his criticism should be directed at H. J. Novy. That 40 per cent of Scottish graduates go south is an oft-stated fact. Little wonder! At interviews held at Glasgow University and Technical College this year, over half the firms represented were English.

I have no axe to grind personally, being fortunate to have served with non-Scottish firms throughout my career, and would like to point out that I tried in my original letter not to express personal opinions, but to give a general impression of student opinion.

There is, however, a point of criticism I must accept regarding my previous letter. The charge that I was not constructive. That I offered no solution. Allow me to make amends. May I propose that Scottish employers agree to sit on a joint committee with students' representatives to try to determine ways of retaining a higher proportion of our graduates in Scotland; and that more firms offer to maintain students during their studies provided these students are willing to sign a two-year post-graduate contract?

I also suggest that a scheme be introduced by the shipbuilding firms in which students may spend their vacation training at different yards thus giving not only two or three larger companies the benefit of graduate talent, but also the smaller firms. This scheme should be operated on the basis of the training scheme now practised by the Scottish electrical industry. Further, that the excellent facilities for management training in Scotland, Glasgow in particular, be more substantially supported.

Finally, I have no doubt that Mr. MacLellan's organisation run an excellent training scheme, but that his company is typical of Scottish industry in general, I know from the numerous contacts I have spoken to on this subject to be pure fallacy.

Yours faithfully,
IAN GORDON.

382 Maryhill Road,
Glasgow, NW.
25 May, 1960.

Draughts in the Room

SIR, With reference to the letter from Dr. O. Kantorowicz (ENGNG., 15 April '60, p. 504) in which he puts forward his theory regarding radiation from high level, and well type domestic fires, the theory may be quite correct but in practice I can say very emphatically that since I fitted an under-floor draught grate, I have always had warm feet when sitting by my fireside. There is no kerb, the hearth tiles are at carpet level and the firebars are below this.

I installed the appliance myself and, I think, made a proper engineering job of it, and I have not had to fit new floor-boards, door or windows to get a draught like a smith's forge fire if required.

There is a tendency for it to puff smoke when the fire is green and I am at present experimenting with a secondary air supply, under-floor.

I have nothing but warm praise (and warm feet) for this type of fire, it is economical and burns bright red to the very last cinder.

Yours faithfully,
D. H. KEENE.

6 Lawn Heads Avenue,
Littleover, Derby.
20 May, 1960.

Thermodynamic Theory

SIR, Will you kindly allow me to comment upon Dr. A. P. Hatton's letter (ENGNG., 6 May, '60, p. 606) respecting my book *Foundations of Thermodynamics with Antitheses and Disputation*?

I am afraid that the reader of Dr. Hatton's letter may get an altogether wrong impression of my book by his altogether disregarding its *pièce de résistance*, that of thermostatics and reversible change and, at this juncture, by letting his rather irrelevant exposure of a modern school of "irreversible thermodynamics" dominate his commentary. By Dr. Hatton's account of it, this school attempts the logically impossible, namely, to apply exclusively the differential-equations of the equations of state (of macroscopic rest), that is, the equations of reversible change, on dynamic, spontaneous or explosive, change.

At the same time, he affirms the primary and fundamental importance of my subject matter and since this is the point at issue, I see no reason at this time to get involved in the secondary but technically important problems of irreversibility; the factors of which (spontaneity, friction and leakage) are tractable and may be indefinitely reduced, so that—should we so desire—

the ideal limit, reversibility, may be more or less approximated; as shown in Dr. Hatton's example, Fig. 2 of his letter.

In the introduction to his irreversible discourse, however, Dr. Hatton briefly gives his interpretation of, and judgment on, my statements about the possibility of a *perpetuum mobile of the second kind* (abbreviated to *p.m.s.k.*) In the following comments, I will comprehensively and, as explicitly as a letter of this kind permits, amplify my statements.

After an intensive correspondence with several of the world's leading experts in different thermodynamic fields, as reported in my book, the arguments of whom have been mutually contradictory, it now appears incontrovertible that Clausius's equation, "the fundamental mathematical expression for the Second Law,"

$$dQ = T\,dS,\ S \text{ a variable of state}$$

is not generally valid, but merely a special case of my

$$dQ = N\,dS,\ N = T\frac{\left(\frac{dQ}{dV}\right)_T}{\left(\frac{dQ}{dV}\right)_T + V\left(\frac{dp}{dV}\right)_T}$$

That is, Clausius's equation is valid only when $(dp/dV)_T = 0$; for example, when $p = p(T)$ as in the case of phase-equilibrium, and when the unattainable limit of the perfect gas is assumed to be consummated. This my equation and its derivatives are experimentally confirmed by the self same *positive* facts as Clausius's equations; moreover, my theory is self-consistent and does not give rise to the paradoxes of the current theory bespoken in my book. Besides, and what is of special interest to chemical dynamics, hrough it Svante Arrhenius's "energy of activation" is precisely defined as U(T) and that chemical factor, "hitherto loosely referred to as relative affinity," is identified and defined; notions which are ventilated in the articles on "Chemical Action and Chemistry," by H. M. Dawson and Harold Baily Dixon (*Encycl. Brit.*, 14th ed.).

The above reported findings are confirmed in a circumstantial way by Max Planck's "Yet, up to the present, there has not been produced one single binding proof of the Second Law," and A. I. Khinchin's "... the entropy of a system is proportional to the logarithm of the probability of the corresponding state (Boltzmann's postulate) ... All existing attempts to give a general proof of this postulate must be considered as an aggregate of logical and mathematical errors superimposed on a general confusion in the definition of the basic quantities."

A more direct rejection of the experimental nature of the generality of Clausius's equation is given in "Thermodynamic Inquiry, the First Law verus the Second Law"; a paper of mine which I hope will be published shortly. From a current diagram of state or reversibility diagram for air, in the temperature interval 136 to 300° K and a pressure interval 25 to 300 atm, a clear incompatibility between the First and the Second Laws of thermodynamics is indicated.

Since the First Law and the generality of Clausius's equation imply that no *p.m.s.k.* involving isothermal-adiabatic cycles only, is possible, and since the said generality has been refuted, it follows that a *p.m.s.k.* should indeed be theoretically possible.

Finally, from the above-mentioned diagram inside the limits 128 to 302° K and 33 to 125 atm, a theoretical *p.m.s.k. without* isothermal branches has been constructed with the efficiency

$$e = \frac{W_{heat\ eng.} + W_{refr.\ eng.}}{W_{heat\ eng.}} = \frac{W_{net}}{W_{heat\ eng.}}$$

equal to about $+0{\cdot}21$; simultaneously, strictly in conformity with the First Law, an *effective* refrigeration quantity equalling W_{net} is obtained.

As the said diagram and other similar diagrams and tables are all extensively constructed on the basis of Clausius's equation, especially in regard to the S lines, my repeated assertion (on p. 48 of my book), "that even if Clausius's equation were generally true, a *p.m.s.k.* would still be theoretically possible," is amply supported.

Thus, it appears, we have reason to believe in the theoretical possibility of a *p.m.s.k.* With regard to the practical or technical possibility, the apparently very fallacious data available prohibits any judgment for the present.

Yours faithfully,

SVEN SVANTESSON.

Österskär, Sweden.
17 May, 1960.

In the article by Mr. H. J. Novy, "Engineering Growth in the North West" (ENGNG., 29 April '60, p. 582) the reference to Associated Electrical Industries (Manchester) Limited was in error. The first change in the company's name, from the original British Westinghouse Electrical and Manufacturing Company, occurred in 1919. The new name was Metropolitan-Vickers Electrical Company Limited, which remained until 1 January, 1960, when it became Associated Electrical Industries (Manchester) Limited. There was no change of name in 1917; that was the year which saw the termination of American control.

In a letter from Mr. Ernest G. Marklew on "Measuring Floor Noises" (ENGNG., 20 May '60, p. 680) a graph was reconstructed in which the legend was wrongly given. The full-line curves should have represented the "Test (with sample)" and the broken-line curves "Calibration (without sample)."

Events in Advance

Training in Work Study Methods

SIX-WEEK full-time courses designed to provide training for work study officers are being organised by the School of Work Study, 11 Old Burlington Street, Piccadilly, London, W1.

The courses are aimed at preparing entrants up to a level generally accepted as entitling them to act as assistants, observers and administrators in works and offices where work study is being applied. Considerable emphasis is laid on rating techniques. Two weeks of each course are spent working under supervision in offices and factories, thereby enabling students to practise the principles of work study under field conditions. These courses will commence, respectively, on 13 June, 8 August, 19 September and 7 November.

In addition, a number of "appreciation courses," of one week's duration, are being organised. These courses have been designed to meet the requirements of supervisors, planning engineers and personnel associated with the application of bonus incentive schemes. They will commence, respectively, on 13 June, 8 August and 7 November.

The school was founded in 1951 by Mr. John W. Hendry, an industrial consultant.

Exhibitions and Conference

British Plastics in the USSR, Exhibition.—Fri., 3 June, to Fri., 17 June, in the Polytechnical Museum, New Square, Moscow; Fri., 15 July, to Sat., 30 July, in the Exposition Pavilion, Park of Kirowa, Leningrad. Organised by the Plastics Division of Imperial Chemical Industries Ltd., Millbank, London, SW1. Tel. VICtoria 4444.

British Exhibition and Trade Fair.—Fri., 10 June, to Sun., 26 June, at the Coliseum Exhibition Building, New York. Organised by British Overseas Fairs Ltd., 21 Tothill Street, London, SW1. Tel. WHItehall 6711.

Building and Public Works Exhibition.—Sun., 12 June, to Sat., 25 June, at Durham County Show Ground, Lambton Castle, Chester-le-Street. Sponsored by the Northern Counties Regional Federation of Building Trades Employers, 15 Norfolk Street, Sunderland. Tel. Sunderland 5288.

National Engineering Laboratory, Open Days.—Wed., and Thurs., 15 and 16 June. Applications, stating which day preferred, should be sent to the Director, National Engineering Laboratory, East Kilbride, Glasgow. Tel. East Kilbride 20222.

Large Electric Systems, International Conference on.—Wed., 15 June, to Sat., 25 June, at the Foundation Berthelot, 28 Rue Saint Dominique, Paris. Organised by the Conférence Internationale des Grands Reseaux Électriques (CIGRÉ), 112 Boulevard Housmann, Paris. Apply to the British National Committee, Thorncroft Manor, Dorking Road, Leatherhead, Surrey. Tel. Leatherhead 3423.

Nuclear and Electronic Congress and Exhibition, Seventh.—Wed., 15 June, to Wed., 29 June, in Rome. Agents: Fairs and Exhibitions Ltd., 2 Dunraven Street, London, W1. Tel. HYDe Park 5421.

Precast Concrete Industry, Third International Congress and Exhibition.—Thurs., 16 June, to Wed., 22 June, at Sankt Erikshallen, Storängsbotten, Stockholm. Organised by the Bureau International du Béton Manufacturé (BIBM), Brussels. Apply to the British Cast Concrete Federation, 105 Uxbridge Road, Ealing, London, W5. Tel. EALing 9621.

Sewage Purification, Annual Conference on.—Tues., 21 June, to Fri., 24 June, at Scarborough. Apply to the joint secretaries, the Institute of Sewage Purification, 10 Cromwell Place, South Kensington, London, SW7. Tel. KENsington 3885.

Meetings and Papers

Association of Supervising Electrical Engineers

BOURNEMOUTH
"The Work of the National Inspection Council," by E. J. Sutton. Bournemouth Branch. Grand Hotel, Firvale Road, Bournemouth. Mon., 6 June, 8 p.m.

LUTON
"Diesel Electric Locomotives"; Discussion. Luton Branch. Luton College of Technology, Park Square, Luton. Fri., 10 June, 8.15 p.m.

Institute of Petroleum

LONDON
"Exploration and Production Methods: A Symposium"; comprising "Geophysics Today," by Dr. J. McG. Bruckshaw; "Possible Improvements in Drilling," by H. D. Fanshawe; "Advances in Well Logging," by P. Threadgold; and "Partial Removal of H_2S from Crude Oil by Stripping with Natural Gas," by T. R. Shipster. Exploration and Production Group. Fri., 24 June, 10 a.m. and 2.30 p.m.

Institution of Civil Engineers

LONDON
Annual General Meeting. Thurs., 9 June, 5.30 p.m.*

Institution of Electrical Engineers

LONDON
Conversazione. Royal Festival Hall, South Bank, SE1. Thurs., 23 June, 7.30 p.m.

Institution of Mining and Metallurgy

LONDON
Various short papers. Geological Society, Burlington House, Piccadilly, W1. Thurs., 16 June, 5 p.m.*

Institution of Public Health Engineers

LONDON
Annual General Meeting, for corporate members only, at 4.30 p.m. Discussion on "Northern Outfall Works of the London County Council," at 6 p.m. Caxton Hall, ot. Victoria Street, SW1. Fri., 10 June.

Manchester Statistical Society

MANCHESTER
Annual General Meeting. Manchester Reform Club, King Street, Manchester. Wed., 15 June, 5.30 p.m.

Royal Meteorological Society

LONDON
Various short papers. Wed., 15 June, 5 p.m.*

Royal Society

LONDON
"Nature of Central Inhibitory Action," by Sir John Eccles. Thurs., 16 June, 4.30 p.m.*

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London, WC1. (LANgham 5927)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Mining and Metallurgy, 44 Portland Place, London, W1. (LANgham 3802)
Institution of Public Health Engineers, 179-181 Vauxhall Bridge Road, London, SW1. (VICtoria 3017)
Manchester Statistical Society: Industrial Group. Apply to Mr. T. J. Lunt, Ferranti Ltd., Hollinwood, Lancs.
Royal Meteorological Society, 49 Cromwell Road, South Kensington, London, SW7. (KENsington 0730)
Royal Society, Burlington House, Piccadilly, London, W1. (REGent 3335)

COMPUTER

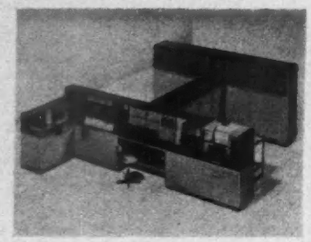
Solving Business Problems

A NEW magnetic tape electronic data processing system, the 1301, is designed to provide the computing power and speed for solving business problems.

In its simplest form the machine is a very fast punch card computer with high speed input and printed output, backed by core and magnetic drum storage, and coupled to a powerful central processor. In its full make-up it becomes a comprehensive magnetic tape data processing system.

The units available are a photo electric card reader operating at 600 cards per minute; two types of internal storage (core or drum) with a choice of capacities; alternative types of magnetic tape transports of either 90,000 or 22,500 decimal digits per second; an output line printer operating at 600 lines of up to 120 characters per minute; and an output card punch running at 100 cards per minute.

The computer is fully transistorised and operates at a pulse rate of 1 Mc/s. Time sharing is used extensively and a



single address system of programming is employed. A comprehensive autocode is available, saving time on programming. The size and operating speed of the basic machine can be increased to meet increasing needs.

Floor space is about 500 sq. ft and loading 100 lb per sq. ft. A three phase mains supply at 246/440 V is required. Owing to the use of transistors, the heat dissipation is only about 4 kW so special cooling arrangements are not normally needed. Air conditioning is advisable when magnetic tapes are included in the system. *International Computer and Tabulators Limited, 149 Park Lane, London, W1.*

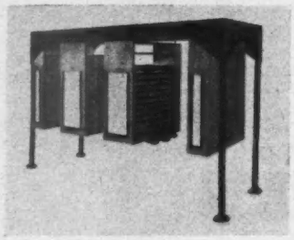
FREE STANDING STORE

Racks or Trays

THE Microstore is a free standing storage unit which can be locked, in which condition it is dust and pilfer proof.

The basic structure stands on four pillars 7 ft high and is 3 ft 9 in wide. The normal length is 10 ft and Coburn tracks run the full length carrying the frames. Of these there are two single sided end units and two or more double sided intermediate units. As the frames are carried clear of the floor they are not liable to become jammed by items collecting under them and the floor can be kept clean. With the installation unlocked the frames can be parted to provide a 3 ft gangway between any two.

Every double sided frame can have 150 bins on each side so that an installation with four double sided units and two single sided ones would have capacity for 1,500 bins. Plastic trays are made either 9 in or 18 in deep, 4 in wide and 1½ in high and can have 2, 3, 4, or 6 cells. Thus with 6 cell



trays the accommodation would exceed 10,000 compartments for the unit mentioned. The trays fit closely together and are free from crevices; they have rounded corners in all planes to avoid catching.

The frames of the store can also be supplied as separate units standing free on the ground. They can be fitted with a wheel base so that they can be used as trolleys or as movable subassembly stores in the factory. In the hanging frame, the size can be extended so that more than four double sided units can be accommodated. *James H. Randall and Son Limited, Paddington Green Works, London, W2.*

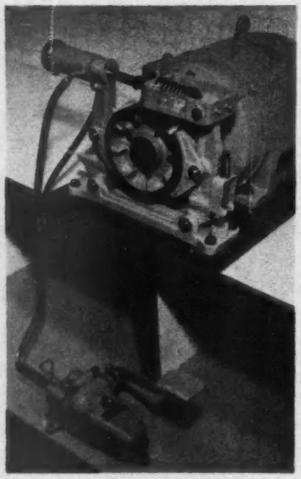
MOTOR BRAKE

Hydraulic Control

THE motor brake illustrated is hydraulically operated to give a very smooth action.

The mechanism is that of the Perigrip brake but adapted for operation by an Exactor receiver and foot operated transmitter unit. Sizes of 8 in and 10 in diameter are available and a 12 in size is being developed. The 8 in size develops a torque of 100 lb-ft.

One advantage of this arrangement is that no loader tank is required for the hydraulic fluid so that the system is simple and compact. The amount of braking is directly proportional to the pressure applied by the foot so the operator has very exact control. For this reason the arrangement is suitable for use on the travel motions of overhead cranes as the smooth braking it supplies eliminates dangerous swinging of the load on the crane hook. Response to foot movement is immediate. Connection between the hydraulic cylinder and the foot operated control switch is by two lengths of flexible pressure hose which may



be of considerable length. *Associated Electrical Industries (Rugby) Limited, Motor and Control Gear Division, Rugby.*

LOADER

Discharge Height of 7 ft

A NEW version of the S2 hydraulic loader has a clear discharge height below the scoop of 7 ft.

The "Hi-Tip" has been specially designed for use where a long forward reach and additional height are needed. The full discharge height is 8 ft 4 in. Other modifications include a reduction in the turning circle and generally more compact dimensions to make it suitable for operation in confined spaces. The dimensions are: length without scoop, 8 ft 9 in; width 4 ft 6 in; and height 4 ft 6 in. Alternative scoops have capacities of one-third and one-half cu. yd.

Power is supplied by a Perkins three cylinder water cooled engine developing 26 h.p. at 1,800 r.p.m. Transmission is through a Kirkstall Forge front axle with planetary reduction to the driving gears. Drive to the front axle is by a flexible coupling with a transfer box in addition to the normal three speed forward and reverse box. A 12 volt electric starter is fitted as standard.

The scoop crowding action is hydraulically controlled to ensure maximum pick-up of material. The scoop remains level at all heights and a weather shield or totally enclosed cab can be fitted. The scoop ram is double acting and the arm lifting ram single acting. *F. E. Weatherill Limited, Tewin Road, Welwyn Garden City, Herts.*

TWIN POWER SCRAPER

14 cu. yd Capacity

NOW in full production by the Euclid division of General Motors is a new twin power scraper of 14 cu. yards capacity.

The 14 cu. yards is the struck capacity; heaped it is increased to 20 yards at the S.A.E. rating of 1 : 1 slope. To be known as the TS-14, the scraper is powered by two General Motors type 4-71 engines each of which has a separate Allison Torquematic drive consisting of torque convertor and four speed semi-automatic transmission.

Maximum fuel economy is achieved by having a convertor lock up in both drives to utilise the full 296 h.p. of the engines on grades and long high speed hauls. Gear changing is under full power operation with air assisted remote control, allowing the selector lever to be moved with the minimum of effort. Both drive axles are fitted with No-Spin differentials and two hydraulic jacks provide full 90° steering. The tyres used are 24·00 by 25.

All the scraper operations for the bowl,

apron and ejector are hydraulically and independently controlled. The ejector is of the positive roll out type actuated by a hydraulic jack that is identical to the apron jack. Two interchangeable bowl jacks are connected to the scraper bowl through heavy duty levers and linkage. The cutting edge consists of four sections that are identical and reversible, each section being adjustable to provide the most efficient loading in any material. The low setting of the bowl gives self loading ability and the all-wheel drive allows a wide range of usefulness for small quantity jobs as well as for big earth moving projects. *Blackwood Hodge, 25 Berkeley Square, London, W1.*

MOTOR CONTROLLER

Static Unit

A CONTROL unit for direct current motors, using only static parts, can reproduce all the functions of a Ward Leonard set in a smaller space.

The system can be used to advantage whenever a constant torque drive is required. The high efficiency of the silicon rectifiers rates the unit above a Ward Leonard set. The armature voltage of the motor to be controlled is varied by means of silicon rectifiers that are duplicated for regenerative braking. These reverse rectifiers can also be employed for reverse operation of the motor if required. Accelerating or braking currents are automatically limited to the deisred level by a current limiter circuit. The machine field is supplied by an auxiliary rectifier.

The control takes the form of a closed loop servo-mechanism in which the speed signal from the tacho-generator is compared with a reference, giving rise to an error signal which feeds the transistorised control amplifier. A linear phase shift circuit supplies four pulse circuits that fire the silicon rectifiers in a bi-phase rectifier-inverter circuit. Speed can be controlled in two ways; by a hand operated potentiometer, or automatically by a programmed reference unit. The latter method lends itself to control by paper tape input. The speed range available is 100 : 1 on the armature control alone, and the load torque is constant throughout the range. A range of various sizes is available. *Brush Electrical Engineering Company Limited, Loughborough.*

In the note describing the "Iron Fairy" hydraulic crane made by British Hoist and Crane Company Limited (p. 642), the permissible load at 5 ft radius should have been 13,440 lb.

In the note describing the new viscosity controller made by Smiths Industrial Instrument Division (p. 480), the accuracy was given as 2 per cent. This was in fact, the minimum requirement; the instrument itself will give results to better than 1 per cent.

REEL LIFTER

Internal Grip

THE device illustrated has been designed for lifting reels of material by gripping on the inside.

It hangs from a standard crane hook and the part that enters the borehole hangs at 45° in the standard models so that it can be used when the reels are stacked vertically or horizontally. The crane hook is slightly over-lowered and the lock-out lever withdrawn; when the crane starts to lift, the arms cause the internal cams to expand and to grip the bore of the reel, so lifting the latter. After placing the reel in the required position, the hook is again slightly over-lowered, releasing the cams and also the lock-out lever which then holds the arms open, allowing the device to be withdrawn as the crane lifts again. The operation is extremely quick and safe.

The lifter was primarily intended for handling paper reeels but can be made in a variety of sizes to suit many other applications. The standard unit for use on a 5 in diameter bore has a 15 cwt safe working load and is inserted about 20 in into the bore. All parts move on ball, needle, or roller bearings which require only normal greasing.

There are simpler models for handling reels that are always vertical, and fully automatic versions are also possible. *British Electrical Repairs Limited, 10 Charlotte Street, Manchester 1.*

PHOTO-PRINTER

Lightweight Machine

CLAIMS made for a new contact printer for photography are that it is light in weight and suitable for air surveys.

The instrument weighs 25 lb and is 23 in high, 13 in wide and 12 in deep, when the spools and arms are stowed for transport. Uniform illumination is given by four 15 watt bulbs, under the control of a rheostat with a range sufficient for both bromide and chloride papers. A 15 watt safe light bulb provides light for viewing. The actual exposure is made by a microswitch operated by the pressure plate. A master swich controls all the bulbs.

Four opal glass sheets are provided for diffusion and for the addition of shading material. They are accessible through a hinged door in the front of the instrument. The pressure plate is faced with closed air cell rubber, and both the plate and the register glass are floating to ensure good contact. The format area is 9 in by 9 in. The spool arms will carry up to 250 ft of film, 9½ in wide. The printer is finished matt white inside.

All the controls are grouped in the base of the unit where adequate ventilation is provided. It is claimed that despite the small size and light weight of the printer, perfect contact can be maintained between negative and positive with uniform illumination and ease of operation. The standard unit is designed for operation from a.c. mains. *Fairey Air Surveys Limited, 24 Bruton Street, London, W1.*

WORK BENCH

Apprenticeship Training

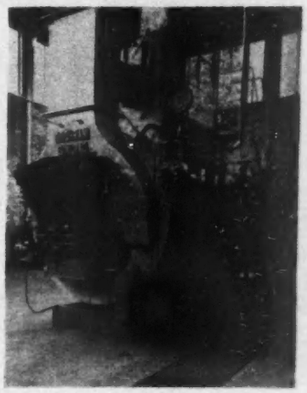
DEVELOPED originally for an apprentice school, the Individual work bench is now on the market.

The bench is made of tubular steel, and has an adjustable drawing holder which also supports a screen for use when chiselling is being carried out. Mounted on the steel column is a wooden top that can be renewed without difficulty and which also protects delicate instruments from damage. The standard equipment is a fitter's vice of the swivelling type.

Below the work top are two drawers that can be locked with one padlock, providing enough space for storing a full set of tools. The larger is long enough to hold files. The work top is 2 ft 8 in above floor level with the edge raised 1 in. The width of the top is 1 ft 6 in, and the length 2 ft 10 in. The pedestal is secured to the floor by three foundation bolts. The whole bench without a vice weighs 150 lb; with a vice this is increased to 192 lb. It is claimed that for apprentices the sense of ownership develops a feeling of responsibility. The bench has many obvious applications for toolrooms and the like. *Baker Perkins Limited, Westwood Works, Peterborough.*

PACKAGED BOILER

Coal or Oil Firing



THE Sinupac is a horizontal packaged boiler that has been designed for firing by coal or oil.

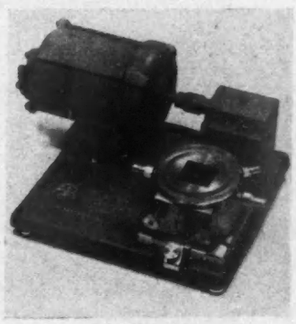
The range covers models with evaporative capacities from 3,750 to 37,000 lb per hour, with efficiencies of over 80 per cent over a wide range of operating conditions. Response to fluctuating loads is said to be rapid. The boilers can be used for steam or hot water supplies at working pressures up to 250 lb per sq. in.

The oil fired version is fully automatic in operation, the steam pressure being maintained within narrow limits. Fuel and air supplies are linked so that good combustion is maintained over the turn down ratio of the burner when the standard rotary cup type is used. Boiler feed is made up automatically and there are safety switches for low water.

For the coal fired model, which is illustrated, a coking stoker is normally used, in conjunction with an induced draught fan, and operation can be made automatic. The largest model in the series has a shell diameter of 13 ft 6 in and is 21 ft long. Width and height are 18 ft 11 in and 15 ft 1 in respectively. The three largest models can be fitted with three tubes instead of the standard two, if required. *Cochran and Company, Annan, Limited, Newbie Works, Annan, Dumfriesshire.*

LABORATORY MIXER

Small Batches



BATCHES of material from ¼ to 2 fluid ounces can be mixed in the Micro-Mixer illustrated.

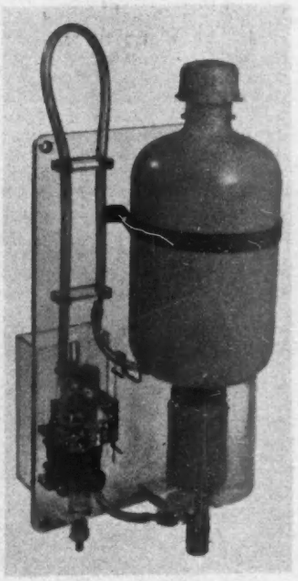
The machine can operate under vacuum down to 1 or 2 mm. of mercury. The walls are made thick and the Plexiglass lid is not mechanically held, to allow the safe mixing of explosive substances. When working under vacuum the lid is sealed by an O-ring.

Mixing is performed by two Z-shaped blades, one of which revolves at 55 and the other at 70 r.p.m. Clearance is 0·020 in. The blades run in nylon bearings sealed with vacuum tight O-rings and can be easily removed for cleaning. Reassembly takes less than a minute. All parts are precision machined out of stainless steel and polished, except for some outside items like the base plate, which is aluminium to save weight. The entire mixer can be slid clear of the couplings transmitting the drive from the gear box.

Provision is made on the mixing chamber for water cooling when materials need it. Connections are placed on opposite sides and pressures up to 40 lb per sq. in can be used. Power is supplied by a ¼ h.p. explosion proof motor running at 1,725 r.p.m. The blades revolve in opposite directions and there is no metal to metal contact at any time. The base on which the unit is mounted measures 13 in by 15 in and the overall height is 9 in. Liquids can be handled as well as solids. *Atlantic Research Corporation, Alexandria, Virginia, USA.*

DRIP REGULATOR

For All Liquids



CONDESCO drip feed regulators are designed for the dosing of acidic or alkaline liquids.

The units consist of a main storage bottle feeding into a smaller container so that a constant head is kept in the latter. This enables the drip regulator valve to maintain a very constant output. The bottles are made of polyethylene and the valve is constructed entirely of polymethyl methacrylate. All metal parts are covered and the units are unaffected by corrosive materials.

The fully automatic model illustrated has a cutoff valve operated by a hydraulic cylinder which is itself connected to the output of the final rinse pump (in a bottle washer) or a similar pressure source so that liquid cannot flow from the drip valve until pressure is applied. Thus waste is prevented. The normal size of regulator is 1 gallon and rates may be less than four drips per minute (one fluid ounce contains 400 drips on average). *Lyne Frank and Wagstaff Limited, London Road, Enfield, Middlesex.*

Upward Trends in Europe's Electricity

Inquiries by the OEEC show that there has been a substantial development in Europe's electricity supply industry during recent years and that it is likely to continue.

By Richard Bailey

For the past six years the Organisation for European Economic Cooperation has published reports on the "Trends in Economic Sectors." As part of this series the Organisation's electricity committee has just brought out the findings of its tenth inquiry into the electricity-supply industry: *The Electricity Supply Industry in Europe*, OEEC (HMSO, price 12*s* 6*d*). The report falls into four main parts:

(1) a general picture of the industry in 1958 and early 1959.

(2) developments from 1948 to 1958 and medium term forecasts for the period 1959 to 63, with special reference to plant, output, exchange, consumption, cost and prices, investment and manpower.

(3) long-term factors affecting future trend of production.

(4) the main activities of the Electricity Committee in 1958 and 1959 and its role in international cooperation.

TEN YEARS OF EXPANSION

The demand for electricity has been expanding rapidly over the past ten years. In 1958, power production was of the order of 450,000 million kWh. Of this, 180,000 million kWh were produced in hydro-electric plants and the rest was produced in conventional power stations which used the equivalent of some 140 million tons of coal. Installed capacity in 1958 amounted to 125 million kW, and new investment accounted for $3,600 million. This increase in supply and capacity must be seen alongside the great increase in consumption. In the ten years to 1959, electric power consumption in the OEEC countries rose by 130 per cent. In the same period industrial production went up by 93 per cent, national income by 62 per cent and total consumption of all forms of energy by 47 per cent.

This was the position of the European electricity-supply industry in 1958. What had been the principal developments in the preceding ten-year period? The general upward trend slackened in 1957 and 1958 following the slowing down in industrial activity. The annual rate of increase in the consumption of electricity, which had been 8·9 per cent in 1956, fell to 6·1 per cent in 1957. New plant brought into service in 1958 reached the record of 5,550 MW for thermal power stations and 3,450 MW for hydro-electric capacity. The hydro-electric schemes which were part of a long-term programme went ahead according to schedule, but conventional power station building was slowed down.

The situation obviously differed from country to country. The biggest increases in consumption took place in Greece and Turkey, and, in the hydro-electric producers, Norway, Sweden and Portugal. Exchanges between countries were carried out on a complicated pattern designed to achieve two main objectives: the daily compensation by exchanging peak power during the daytime against base load during the off-peak night hours, and to secure seasonal compensation enabling the hydro-electric countries to maintain a steady production by exporting hydro-electric power in spring and summer and importing thermal power during the autumn and winter.

The recovery of the electricity-supply industry after the war was remarkably swift. By 1945, reconstruction work and repairs had already brought production above the 1938 level. After that time, there was the need to expand in order to make up for ground lost during the Second World War and to meet the needs of increasing industrial development. Two factors combined to increase the rate of consumption: the tendency to multiply the uses of electric power, which the report estimates accounts for a 4 per cent increase each year, and the variations in industrial activity. A 1 per cent rise or fall in the index of industrial production involves a corresponding movement of 0·6 per cent in power consumption. The fact that industrial activity has risen by 7 per cent in the ten years under review has led to an increase in demand of 8·1 per cent.

So far as plant is concerned the time lag between the decision to build a power station and the moment when its effects are realised can mean that new plant is coming tinto use at the very time when consumption is falling. This happened in 1952-53, in 1953-54, and again 1957-58. The report stresses the need to spread development plans evenly over as long a period as possible,

How was investment and production shared between the different types of plant? Thermal power station capacity increased from 35,200 MW in 1948 to 75,700 MW in 1958, and the forecast is a capacity of 106,000 MW in 1964. The average yearly rate of expansion, which has been 8·0 per cent over the past ten years, is expected to average out at 5·2 per cent in the years up to 1964. The big increase in demand during the period meant that a lot of obsolete plant had to be kept in operation. However, the situation has now changed sufficiently to make it possible to go over to the building of high-efficiency plants only and to scrap much out-of-date equipment.

Fuel is another factor that has changed during the period covered in this report. Coal and brown coal were formerly almost the only fuels used, with blast-furnace gas in some special areas. Recently, however, fuel oil and natural gas have been increasingly used. In 1958, they supplied 10 per cent and 0·5 per cent, respectively, of power-station fuel needs. This tendency is likely to increase and some undertakings are also building dual-fired power stations using both coal and fuel oil. Natural gas is plentiful in Austria, northern Italy and south-west France, but it is doubtful if a fuel of such high calorific value will be more widely used, except, perhaps, as a supplementary fuel, combined with its use in other industries.

The revenue per kWh, corrected for variations in the wholesale price index, has fallen in recent years. It has dropped by 8 to 10 per cent in Germany, Austria, Belgium and Switzerland; prices have remained relatively stable in Britain and have risen slightly in France, the Netherlands and Sweden. A comparison of the average revenue per unit in selected countries during the nine years 1950 to 1958 is shown in the accompanying Table I.

So far as costs are concerned, the report makes three broad generalisations:

(1) hydroelectric power; as the best sites have been used up new schemes will require more work, bigger investment, and will entail high costs per unit of installed capacity.

(2) thermal power; even if fuel prices were to rise, the increase would be offset by the more economical high capacity sets with higher thermal efficiency now being brought into use.

(3) transmission and distribution; the greater density of consumption expected should result in appreciable savings through better use of existing plant.

Taking these factors into consideration the report concludes that costs are likely to go on rising in countries depending primarily on hydro-electric power. Where thermal stations are more important, costs are likely to fall as efficiency increases and this efficiency should rise sufficiently to offset possible higher fuel costs. The development of nuclear programmes may involve higher costs for the time being because of the heavy capital outlay involved, which has to be borne by the industry as a whole. Nonetheless, nuclear programmes for the next five years are not sufficiently important to justify any immediate revision of tariffs.

The report brings together a number of forecasts made in various studies by the Energy Advisory Commission and other OEEC committees. In round figures, it accepts the estimate that the "probable approximate figure for consumption" in 1975 will be 4,000 kWh per head. This is about the present level of consumption in the United States.

Hydro-electric power, which at present accounts for 40 per cent of total production, is forecast to represent only 26 per cent in 1975. The proportion of base load carried by hydro-electric supplies is expected to fall from 33 per cent in 1958 to 22 per cent in 1975. Nuclear energy presents rather more problems for the forecasters. "As a rough guess" the report suggests that nuclear energy could become competitive "in all parts of Europe" around 1975 on the basis of 6,000 hours running time a year. It will not become competitive with conventional energy before 1975. The forecasts for thermal power follow on from those for hydro and nuclear electricity.

Consumption of high grade fuels is expected to level off between 1965 and 1975, but the consumption of brown coal and blast-furnace gas will go up as fast as supplies will allow. The forecasts for production and installed capacity are summarised in Table II.

TABLE I.—*Average Revenue per Unit adjusted for Variations in the Wholesale Price Index from 1950 to 1958 in Selected Countries (Public Utilities)*

Country	1950	1951	1952	1953	1954	1955	1956	1957	1958
Austria	100	102	103	104	97	92	—	—	—
Belgium	100	83	94	99	97	92	—	—	—
France	100	86	100	105	109	107	—	—	—
Germany	100	83	93	102	98	93	90	—	—
Netherlands	100	90	107	112	107	105	106	—	—
United Kingdom	100	87	91	98	99	98	98	98	102
Sweden	100	90	89	98	99	96	96	100	112
Switzerland	100	85	88	94	95	93	93	—	—
Turkey	100	94	89	87	80	79	—	—	—

Sources: "The Trend of the Selling Price of Electricity," Table 43 of the OEEC Publication for November, 1958; the OEEC *Statistical Bulletin.*

TABLE II.—*Forecasts for Production and Installed Capacity during 1965 to 1975.*

—	1955	1965	1975
			(round figures)
Installed capacity (GW)—			
Conventional thermal	61·6	115	205–185
Nuclear	—	5	15–35
Hydro	40·0	70	110
Total	101·6	190	330
Production (TWh)—			
Conventional thermal	220·6	410	800–680
Nuclear	—	30	90–210
Hydro	149·4	260	410
Total	370·0	700	1,300

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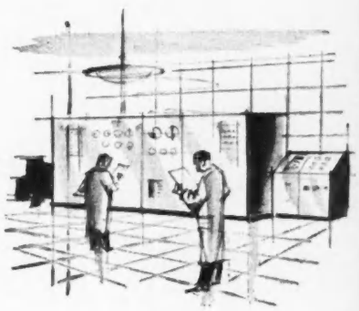

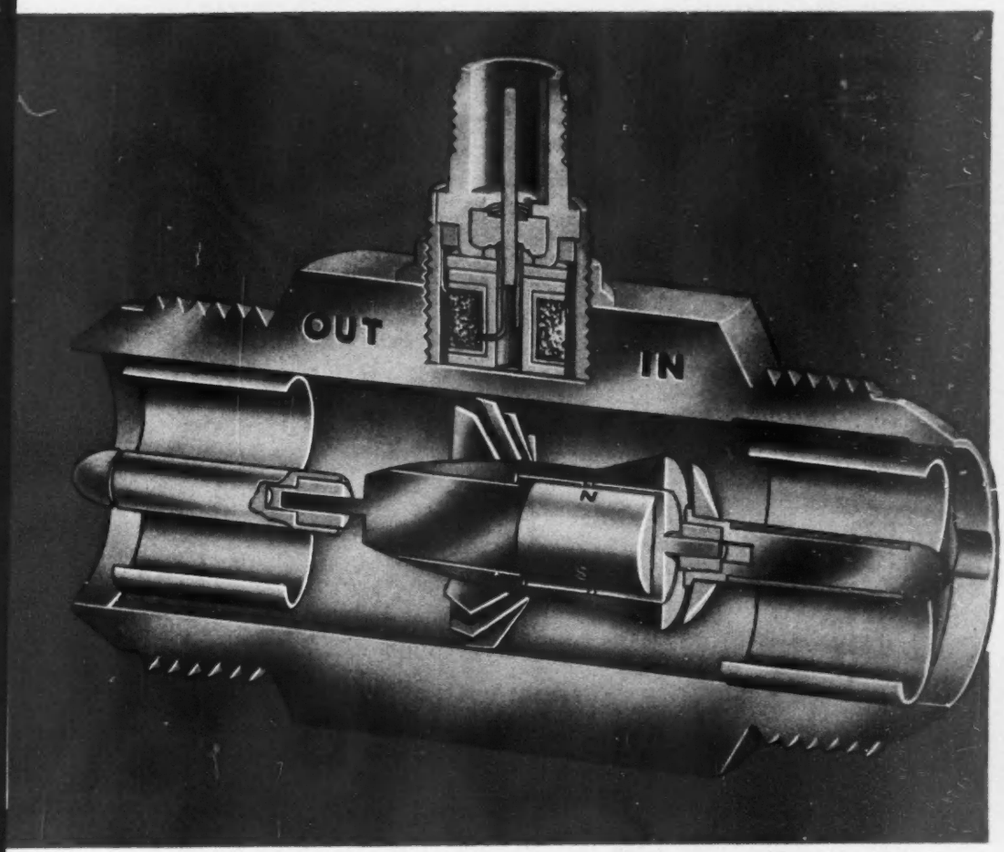

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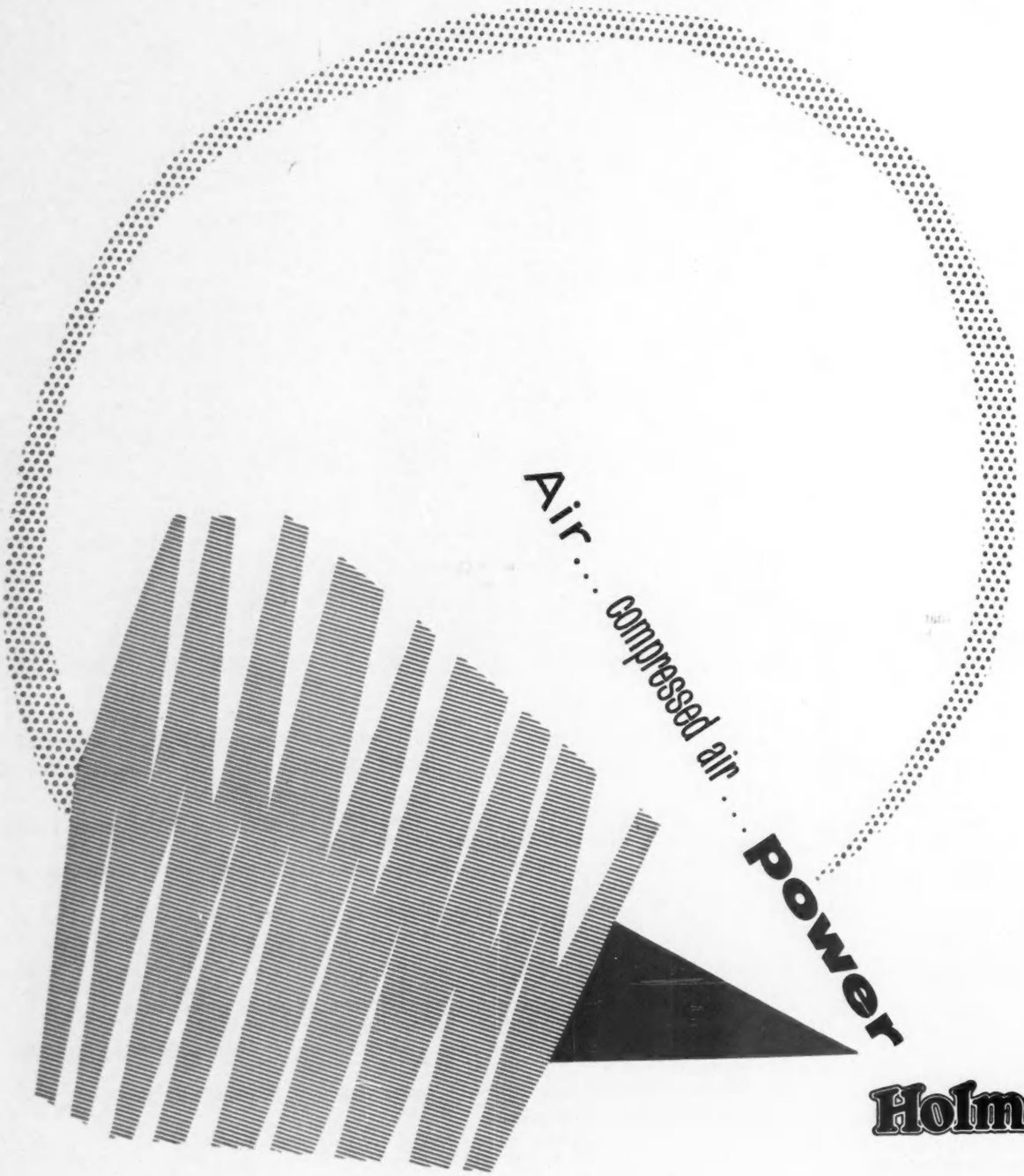

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HM8

Human Element

Stimulating Burglars?

HAS the considerable technical and designing skill devoted to keeping the burglar out challenged the technically, but not morally, minded to go into the "screwing" trade?

This pessimistic thought was entertained by no less an expert than Mr. Cecil V. Hart, the assessor, in a recent talk to the Insurance Institute of London.

What Mr. Hart said was: "I am convinced that scientific progress has acted as a challenge to the thief of ability and technical knowledge who would not otherwise have been interested in acts of housebreaking, when the only necessary tool of his trade was the jemmy."

Over the years protection against the housebreaker has been matched by illegal ingenuity in much the same way as "improvements" in military equipment, like the tank, have been matched with developments in artillery.

From the old rimlock, whose cast iron socket could be fractured with a jemmy, door protection advanced to the spring cylinder latch. This could be turned by breaking the glass and reaching in to turn it, or by the more vigorous use of the jemmy than with the rimlock. Various methods of safeguarding this lock are practicable.

The 2 and 4 lever mortice deadlock was reasonably sound against the jemmy but there are thieves about armed with only five skeleton keys who can open any of these. The mortice deadlock is now up to five levers and is believed to be so far unbeaten in Britain. But its defeat is on the way. Mr. Hart has received information that a key stem with stiff nylon bristles has been invented which gives the depths of the wards and tumblers. From the United States we have just received another method by which a stem is inserted into the keyhole and spring bolts released. This also gives the information from which a key can be cut.

Under Water High Speed Flying

Some horrific photographs have appeared from time to time of men being swung on centrifuges at great speeds, usually to discover the effects of leaving an aircraft flying at speed.

Now, staff of the Royal Air Force Institution of Aviation Medicine, at Farnborough, Hampshire, have achieved the same effects at only 1/28th of the speed.

By rotating the arm of the centrifuge through water at a speed of 20 knots, with the human "research monkey" attached, effects equal to a speed through the air of 515 knots are reached.

The revelation of this new twist in under-water activities was given at the United States 1960 congress of the Aero-Space Medical Association meeting in Miami, Florida.

Two men from the IAM, Squadron Leader D. I. Fryer, and Mr. R. W. J. Needham, have conducted 58 of these experiments, using the rotating beam at the Admiralty research station at Teddington, Middlesex.

The programme has been going on for a year, studying the effects of wind blast in order to get information on the limits of tolerance when a man, unprotected, is ejected from a high speed aircraft.

The use of water in testing the human frame recalls the water tank trials of the Comet fuselage after its early setbacks.

Hood Photography Medal for Walter Nurnberg

The Royal Photographic Society has awarded its Hood Medal to the industrial photographer Walter Nurnberg.

The Hood Medal is given for meritworthy performance in advancing the achievements of photography.

Walter Nurnberg, a 53-year-old naturalised citizen living in North London, has taken cover pictures for ENGINEERING since 1952. An advertising photographer when he came to Britain from Germany in 1934 he turned to his dramatic black and white industrial photography after serving through the war with the Army.

His clients now read like the first division champions of British industry. They include English Electric, Davy-United, David Brown, Mullards, and Hoover. Nurnberg's books on photography are well known among professionals and the more advanced amateurs.

Two in particular have gone into numerous translated editions. They are *Lighting for Photography*, now in its 13th British edition, and *Lighting for Portraiture*.

Telling the Public About Industry

The practical business of much of public relations in Britain is getting the right information into the Press and on to the air at the right time.

Since in earlier days far larger newspapers than today's appeared entirely without the aid of press officers or PR men, the value of their activities must be considered in relation to industry and not as a two-way operation benefitting the clients and the organs of information. From the journalist's view the apparent value of being able to reach an individual whose function it is to give information is balanced by the ease with which the man who takes the decisions can be hedged about by those who refer all the questions to "our spokesman."

But the industrial concern is part of the community from which its labour is drawn and where, in most cases, the majority of its customers are found. This is hardly news, but since the war the need to tell the public what the company does and plans to do has spread from the efforts in the 1930's of the Post Office and the North Thames Gas Board to a widespread public relations performance by many thousands of men and women, on company staffs and in PR agencies.

The most important single fact about the profession is that it is very new and still developing. The direction it will take is important for the future since it bears directly on the kind of view the public gain of industry and commerce, and it will increasingly affect the view industrial leaders have of their relations with the public.

For this reason the recent American book on the subject *The Image Merchants*, by Irwin Ross, a New York journalist (Weidenfeld and Nicolson, 21*s*) is important. It is unreasonable to imagine that the present pattern of United States PR practices will not help to shape our own in the not distant future. The humble business of handouts scarcely detains Mr. Ross for a line.

For what, in the last resort, the characters in Mr. Ross's book are engaged in is manipulation. As far back as 1928 Edward L. Bernays, the dean of American public relations, had written an essay with the title "Manipulating Public Opinion."

It is no good a company putting out statements describing its merits. The editorial department could be relied on to give them a swift burial. Instead, advises the public relations counsellor, let there be scholarship programmes, lay on symposiums on subjects of general public concern (there is no need to say who pays the fare of the platform luminaries), underwrite an orchestra, anything that is of unquestioned social benefit and is itself news.

Orchestras and Reports

The effects are twofold. The scholarships and the music are undoubtedly good and worth having. And when the annual report comes out, or a strike blows up, that important person the common voter, reacts to the affair not coolly as a stranger but with some of the commitment of one looking at the affairs of a friend. After all his son may not hold the scholarship but he has hopes for the boy. And he always intended to go to concerts.

More serious are the campaigns to do down a particular piece of legislation that may affect one industry against another. Ross tells at length of one furious campaign, on behalf of the Eastern Railroad Presidents' Conference, in which Carl Byoir and Associates set up resoundingly named organisations and poured out propaganda against the road haulage interests (truckers) of the North Eastern United States.

It goes without saying that within the organisation can be found those who see no moral objections, who claim that the propaganda is true and that it is a proper thing to do to organise 'civic groups' to say so loudly and often.

The weakness lies in the eventual discrediting of all apparently independent groups. Once the public get to hear that such bodies as the New Jersey Automobile Owners Incorporated was largely brought back to life for commercial campaigning purposes and that even the speakers at the women's clubs are coming with their fare paid and their speech written in a special (company) case, the reaction to all and any expressed opinion will be—whose paying him?

Expounding the Case for Steel

United Kingdom public relations may or may not be in the infant stage compared with the organised opposition of which American PR industry is past master. In one important detail it has a similarity to its trans-Atlantic big brother. This is the not unimportant question of whether a PR campaign, other than one designed to prevent legislation, has any measurable effect.

Cases can be quoted on either side. Interest in Great Britain on public relations leads often enough to the case of steel nationalisation. Technically far advanced, with a labour relations record an example to the nation at large, the full page advertisements of the steel industry leave the reader in no doubt of these facts. But it was not always so willing to tell the public.

A recent book from a British public relations executive, Mr. Mike Williams-Thompson, *On The Record* (Frederick Muller, 21*s*) indicates, inadvertently, the difficulty in assessing public relations effectiveness. Williams-Thompson was chief public relations officer for the Ministry of Supply when the Labour Government nationalised the steel firms. He was responsible for presenting steel nationalisation to the public and says, modestly enough, "I and my staff made a praiseworthy job of it—a classic example of first-rate government public relations work."

The speed with which the electorate returned to power a Government with steel de-nationalisation an important part of its platform is evidence that some PR operations are less lasting than the claims of their exponents.

All Sorts and Conditions of Research

Each year the research information committee of the American Institute of Industrial Engineers asks as widely as possible for details of research performed in industrial engineering.

Both the universities and industry get the benefit of the published abstracts. The Institute is currently engaged in seeking all it can find in university departments, industrial concerns, research institutions, non-profit-making bodies, government agencies, and professional societies.

The breadth of the Institute's coverage is indicated by the subject heads. They are:

Work measurement
Methods
Plant engineering
Human engineering
Engineering economics
Organisation planning
Industrial statistics
Production control
Data processing
Operations research
Cost analysis
Industrial engineering education

The man at the heart of this annual round-up is Dr. Jay Goldman, chairman of the research information committee, of the Department of Industrial Engineering, Washington University, St. Louis, Mo., USA.

African Advancement in Rhodesia

Small, but significant, steps for the improved contribution of Africans to the working world of Rhodesia have been ratified by agreement between the Northern and Southern Rhodesian Governments and the trade unions.

African lorry drivers on certain duties are to have fresh classifications and to be paid at least double. Certain promotions into jobs formerly reserved for Europeans will also take place, probably first of all in railway dining cars.

The Amalgamated Engineering Union voted for the agreement but the Rhodesia Railway Workers' Union opposed the steps for improved positions for African workers. Once outvoted, however, the railway union undertook to cooperate.

Cunning and Colour at New York Exhibition

An exciting account of British inventiveness and productive ability, the New York exhibition covers everything from the Conway by-pass engine to the penny black stamp. The engineering industries' enthusiasm for the show carried them over from the allotted second floor to occupy part of the first.

THE American legend of Britain as a nation of beefeaters living in Cotswold thatched cottages will receive a lively jolt with the opening in New York on 10 June of the biggest overseas exhibition of British industry ever staged.

The major television networks and the Press of both American continents will be carrying the story of British technical achievement to an audience numbered in tens of millions, strictly on its news value.

For the first time since its erection, the four storey Coliseum Building on Broadway (near Central Park and the Carnegie Hall) has the whole of its 391,500 sq. ft of exhibition space fully utilised. From the industrial giants of the United Kingdom, Rolls-Royce, Associated Electrical Industries, British Insulated Callender's Cables, to modest manufacturing companies whose names are scarcely known beyond their customers, a $10 million effort has gone into the mounting of this strategically timed show.

Strategic because last year the United Kingdom's exports to the United States for the first time exceeded $1,000 million. This is still only a handful of dollars per head of the American population's multi-billion spending each year. And the appeal of quality is equally timely. Throughout the United States, Mr. W. H. McFadzean, President of the Federation of British Industries, told ENGINEERING, chambers of commerce and other bodies have been "tremendously" cooperative.

But not every US businessman should be expected to throw his hat in the air at the prospect of increasing sales of British products in his home market. For this reason a strong connection needs to be maintained with the customers if counter-advertising and perhaps tariff appeals are not to win in the first round.

The fast expansion of United Kingdom exports to the United States at the end of the 1950's demonstrated, as the increasing trade between the developed states of Western Europe also showed, that some basic assumptions of business needed looking into. The best markets for manufactured goods are not necessarily the developing states who have enormous needs but low incomes.

LIMITLESS MARKET

The already well provided and wealthy communities, of which the United States is at present the supreme example, are accustomed to re-equipping themselves so fast that the market potential seems almost limitless. For the British exporter there are special reasons why he should not be discouraged by the distance.

American transport charges are so high that the Eastern seaboard United States producer pays at least as much to move his goods to San Francisco and California as the industrialist shipping his product there from London. When this and other facts like it sink in, the $1,000 million value of exports last year may be left far behind.

That the manufacturers of the United States are capable of massive campaigns of counter attack is best instanced from the way in which Detroit has turned to "Compact Cars." These may have been coming anyway. No one has satirised the big, fat American car, almost dropsical in dimensions, more than the native cartoonists, but its direct effect is to make the going much less certain for British car exporters.

American compacts may hit foreign car exports more or less impartially, though apparently not the Volkswagen, and the same applies to the beneficial conditions for trade. There is no shortage of well thought out competition from Western Germany, Scandinavia, Italy and Japan.

So there is more than adequate reason for making sure that British industry, its abilities and consumer products, make a clear impression through the Exhibition. And a lasting impression.

This is something the designers have almost certainly succeeded in.

The British lion, not the overfed or nervous looking type, but a lean and muscular beast, appears in a number of settings that can be called dramatic by any standard. The exhibition designers have not indulged the American love for drum majorettes but they have put the lions in charge of model mannequins. Not just models of pretty girls but with the heads of unicorns, and one even dressed in hunting pink.

Rolls-Royce Silver Cloud II against the traditional background of Windsor Castle.

To take the exhibition in order, the great ground floor of the Coliseum building is given over to the Government display of industrial and scientific achievement. Jodrell Bank, the Sputnik-tracking radio telescope, the Hovercraft, the Melrose heart-lung machine developed at the London Postgraduate Medical School, Calder Hall, the first full-scale atomic power station, are all shown, either in model or picture. A heart-lung machine will be shown functioning.

Among the facts to be told to the American visitors are some that will surprise them. Most of the lenses in Hollywood's cameras come from the United Kingdom, so does some of the justly vaunted air conditioning equipment, and so do many of the policemens' whistles, the table tennis balls, and the needles, and of course the Scotch, the smaller cars and the Rolls-Royces.

Among the composite displays to which the visitor walks after the Government exhibit are those of the British Iron and Steel Federation and the British shipbuilding industry.

The steel display's exhibits and photographs illustrate the comprehensive nature of the British steel industry, the modern techniques and the quality of the finished products.

An original Bessemer converter, believed to be one of the first made after the process was patented, has been lent to the display by the Science Museum, Kensington. It was due to Bessemer's invention of the converter that Britain was able to lead the world into the era of abundant low-cost steel. Stainless steel was the discovery of another Englishman, Harry Brearley, and the metal is everywhere in evidence at the Exhibition, particularly in the jet engines and the atomic reactors.

In the present rapidly changing British steel industry 85 per cent of the steel comes from the open-hearth process. Altering these furnaces to become intensive users of oxygen in some cases doubles the output and cuts the fuel consumption to a fifth. Part of the display shows how such a furnace works. The process is controlled by push-button from a desk.

On the stand, steelworker Mr. Loman Welch, a first hand steel smelter from Lincolnshire, will be operating the controls. He is in the United States as the guest of the United Steelworkers of America.

Among the exhibits made from steel and shown in the display are: sporting guns, court swords, diplomatic swords, steel hand tools, precision gauges, steel springs, umbrella frames, domestic clocks, cutlery, micrometers, steel sheet curtain wall panelling, steel tubes, wire rod and a fully hardened forged-steel roll used for cold rolling of steel and other metals.

It was a measure of the vigour with which the British engineering industries welcomed the opportunity presented by the Exhibition that their stands overflow from the second floor to the first, which was intended to be confined to a super-quality Bond Street of consumer goods

On whichever of the two floors they happen to

Advanced features of the Triumph Herald are weapons in the battle with the US Compacts.

Forged steel boiler drums by the English Steel Corporation.

have found a stand the engineering contributions range through heavy and light products, electrical, mechanical and chemical, machinery and equipment for industrial processes, plastics, office equipment, agricultural machinery, radio and television, instrumentation and electronics and automation.

Rolls-Royce appear in three different guises. In the comprehensive motor section, as aero-engine makers, and with two engines from the oil engine division of the company.

The aero engine division is showing three engines: the Conway by-pass, with thrust reverser and noise suppressor as used on the Boeing 707-420; a Tyne prop-jet and a cut-away motorised Avon turbo-jet engine.

From the Shrewsbury works, the oil engine division will be showing an 8 cylinder turbo-charged marine engine, suitable for high-speed launches and work boats. The division will also be showing a 6 cylinder engine now being supplied to International Harvester, Canada, for their diesel powered road vehicles.

Far above the family car versus compact car battle, the motor Car division of Rolls-Royce shows a Phantom V seven passenger limousine by Park Ward and a Silver Cloud II saloon. The new aluminium V8 engine is also displayed with an illuminated panel showing the main features of Rolls-Royce and Bentley cars.

Almost as wide in range as the engineering floor itself is the field covered by illustrations on the Vickers stand. Their reactor simulator has been designed and developed by Vickers-Armstrongs at the South Marston works, Wiltshire, for the needs of universities, technical colleges and research laboratories at home and abroad. This machine can simulate continuously up to a level of 100 kW, any thermal or fast fission reactor, running at low power. Other Vickers illustrations show the Viscount 810 prop-jet, the rear-engined VC 10, ships, a 210 h.p. Vigor tractor, production and testing machines, pumps, steering gear, office furniture and nuclear equipment.

Thomas De La Rue are showing two machines, one, now sold to more than 140 banks in 50 countries, can check one hundred notes in seven seconds without needing adjustments to accommodate kinds and sizes of currency.

The second, the 500 Type Notemaster, counts notes automatically off in hundreds, or can be switched for any chosen number from one to 99. This machine makes pay packet preparation in a large works a much less time consuming business.

The products of 15 engineering firms are brought together on the stand of the Birmingham Engineering Centre, which at least on its stand has thoughtfully changed its name to Engineering Center for the occasion.

Close to the stand of the British motor industry the Centre's efforts are concentrated on putting the small to medium sized firm across. One of its exhibits will be an experimental steam turbine designed by Belliss and Morcom, of Birmingham, for use in universities and technical colleges. The Morgan Crucible Company, with works in London, Jarrow and Neston, are showing Crusilite silicon carbide furnace elements supported by a working demonstration furnace, a range of Morganite sealed potentiometers, heavy duty ceramic resistors for high voltage circuit breaker and transformer applications, and sparking plug resistors.

Horizontal and vertical hydraulic presses by Finlay Engineering, of Newport, Monmouthshire, will be shown in illustrations.

A. G. Thornton, of Manchester, who are important producers of drawing instruments, slide rules and adjustable set squares, will be showing a selection of their output now widely in use in Government offices, nuclear power research establishments and in industrial concerns in the United Kingdom and the Commonwealth.

Understandably the attention paid by the motor

Fifteen engineering firms of medium size and major ability are on the Engineering Centre's stand.

industry to the Exhibition has been intense and the result has been a collection of cars and trucks on the second floor which have something of the air of the annual Motor Show in London. Sports cars, from Aston Martin, British Motors, Rootes and International Standard Triumph are all present, accompanied by the more sedate offerings—" economy sedans " from Austins to Wolseleys and from Ford to Vauxhall. Counter attacking the Compact cars with their advanced development of the popularly priced Hillman are the Rootes organisation. This car is widely advertised in the United States as the first light car with automatic transmission.

A great deal of interest has been aroused among Americans, who take their motoring technically, by the Triumph Herald with its bolted instead of welded construction and its four wheel independent suspension.

The magnificance is provided by the Rolls-Royce limousine and saloon.

Rather more work-a-day are the specialised food delivery vehicles of the Gateshead-on-Tyne company, Smith's Delivery Vehicles. This company got started in its North American sales by appearing at the Toronto Fair in 1952.

It is now showing a model, specially adapted for the US, of its NCB electric " Commuter " which is designed for house to house deliveries. The driver has easy access to the load which is enclosed and insulated to meet US regulations.

From Associated Electrical Industries the principal exhibit on its 1,300 sq. ft stand will be the AEI electron microscope. With its image intensifier it is possible with this to see minute particles magnified on the television screen to more than a million times.

British Thomson-Houston, who are now AEI (Rugby), were pioneers of centimetric radar, building their first radar equipment almost 20 years ago. The BTH Escort equipment is fitted to the Queen Elizabeth, on which some of the British industrialists will have travelled to the Exhibition.

Among the multitude of electronic equipment being shown, AEI have two types of photo-electric relay for industrial, commercial and domestic use. The second of the two types (FP 22) operates with a light beam of up to 250 ft. Even at that range the clarity of atmosphere can be seriously impaired without affecting the relay's performance.

Among the companies with a record of success in the North American market is the Kilmarnock, Scotland, firm of valve specialists and hydraulic engineers, Glenfield and Kennedy. One order for micro-strainers has been supplied to Canada and a larger order received for several large micro-strainers for a 100 million gallons day project in the United States.

The Gestefax electronic stencil scanner can be operated after only 15 minutes tuition.

A 5ft diameter by 3ft Glenfield Micro-Straining Unit. Glenfield and Kennedy have major contracts in Canada and the US.

Glenfield and Kennedy are showing micro-straining machinery and covering their other activities by photographs.

Well up among the office equipment manufacturers at the Coliseum is Gestetner. Among other of its most recent developments, the company is showing its Gestefax electronic stencil scanner. This machine transfers images directly from the original to a plastic stencil.

The Gestefax is capable of a varied scan by its electronic " eye " of 200, 400 and 600 lines to the inch of scan. The operator adjusts a central button controlling the degree of sharpness of tone. The Gestefax has the considerable advantage of being able to be used by otherwise unskilled members of the office staff.

Among the success stories of last year in the export field was that of the Ford Motor Company's tractor division at Dagenham breaking into the United States home market.

Dagenham Fordson Power Majors and Fordson Dextas will be on show equipped with implements made by the tractor and implement division of the United States Ford company, at Birmingham, Michigan.

Economies With Composite Construction

Composite construction enables full advantage to be taken of the load carrying capacity of floors and the stiffening effect of walls. The technique can be applied to many combinations of materials.

By F. A. Lefever

United Steel Structural Company Limited

At the inception of steel frame construction it was the tendency among engineers to regard the steel skeleton as completely self sufficient and able to support all the imposed loading without help from any other building element. Before long, however, it became increasingly evident that this simple view of the structural action of a building was false and that such things as cladding, partitions and floors not only added to the stiffness of the building frame, but also to its load bearing capacity.

At first, partitions, walls and floors were used structurally as elements to stiffen a frame (which was regarded and designed as a pin-jointed structure) against lateral loads. From these tentative beginnings, steel designers began to exploit more fully other elements of construction hitherto neglected. This tendency has continued and a recent example can be seen in the new issue of BS 449, which now permits the use of the full strength of the concrete fire encasement as an addition to a column's load bearing capacity. It is the purpose of this article to outline briefly other aspects of the general trend towards complete composite construction.

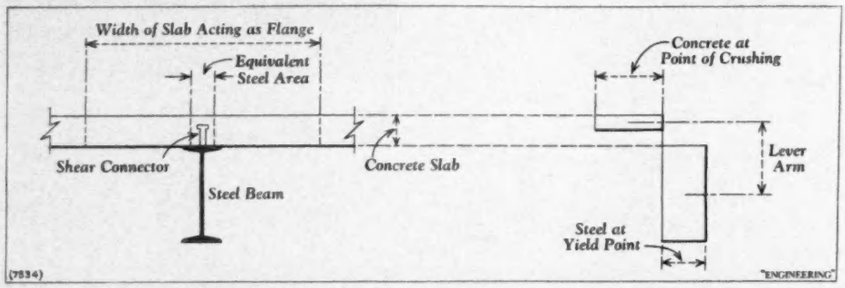
Perhaps the most important development in this connection has been the use of the concrete floor slab of a building as the compression flange of the supporting steel beam, composite action between the two elements being ensured by some type of shear connection, usually in the form of welded "studs," short lengths of angle or T sections, or loops of round bar, spaced along the top flange of the steel beam and often designed not only to provide the required shear transfer, but as an anchorage to prevent the slab from lifting when the beam is in a deflected condition.

Although this idea has its counterpart in the well-known "T beam" of reinforced concrete, certain advantages accrue from composite construction which make it an attractive proposition. The speed of erection, high resistance to shear and the comparative ease with which alterations and extensions to the structure can be made, apply as much to composite construction as to normal steel frames and, in addition, the steel "stem" of the composite beam can be so designed as to support the weight of the concrete slab when poured, composite action taking the superimposed load only. This simplifies the strutting required for the concrete slab.

As will be seen from the illustration, the general conception is a simple one. The width of the slab considered as acting effectively as a flange is derived from the results of tests and is as laid down for concrete T beams in CP 114 (1957) *The Structural Use of Reinforced Concrete in Buildings*. For an "elastic" solution, this portion of the slab is converted into an equivalent steel area by dividing its width by the modular ratio and using the moment of inertia of the resulting combined section in the usual beam formulae. The modular ratio, the factor familiar to reinforced concrete designers, is based on the comparison of the moduli of elasticity of steel and concrete and for composite construction is often considered as 10.

As the modulus of elasticity of concrete is variable, depending among other things on the age of the concrete and its mix, a more realistic estimate of the resistance moment of a composite beam can be gained from a load factor analysis, which, as it is based on the crushing strength of the concrete and the yield point of the steel, does not require a knowledge of the modulus of elasticity of the concrete. The assumed stress distribution at failure is shown diagrammatically in the illustration. It can be seen that full plasticity is considered to be reached over the whole depth of the steel section, the tensile force required to develop this being balanced in compression by a sufficient thickness of slab that is taken to be on the verge of crushing. A load factor (or factor of safety) of 2 is usually considered adequate. The validity of this view of composite beam action is borne out by the results of tests undertaken by the United Steel Structural Company Limited and elsewhere.

There remains the problem of continuity. At intermediate supports of continuous beams, and at certain points in stiff frames where negative bending moments occur, the form of composite beam outlined above would no longer function as such, due to the weakness of concrete in tension. In many instances, this has been avoided by considering the structure as composed of simply supported beams, but this is thought by the writer to be a retrograde step, and many ways of accepting and solving the problem of reversed bending have been evolved.



On the left is a typical composite construction, with steel taking the tension and concrete to take the compression and form the floor slab. On the right is the stress distribution at failure.

Perhaps the simplest of these is to abandon composite action in areas of negative moment and to develop the necessary resistance by locally increasing the steel section, usually in the form of a haunch but sometimes by adding plates to the flanges. There are disadvantages in this method, quite apart from the instinctive feeling that one is avoiding the problem rather than solving it.

A rather better method is to steal a leaf from the concrete designer's book and reinforce the slab locally with sufficient bars to take the whole of the tensile force, but here again, the comparative largeness of the negative moments often make this impracticable, or costly.

The most promising solution is to restore to the concrete slab the ability to resist tension by applying a prestress and thus enable composite action to take place in areas of negative moment. It is necessary to use a concrete of higher crushing strength than is usual for floor slabs, but as this enables the slab to span greater distances and, as a corollary, permits a wider spacing of beams, the scheme is still economically justified.

Two further developments stem from this solution. If the design is so arranged that setting of the concrete takes place and the bond between the slab and the steel section is achieved before the application of the prestress, then prestressing will affect the whole composite section rather than the concrete element alone, with a further reduction in steel weight. The second development is the simple and logical step of precasting the slab in sections which span transversely across the supporting steel beams. This development offers the following advantages:—

(1) The slab units could be cast under controlled conditions, enabling the higher crushing strengths to be obtained cheaply and easily.

(2) The units could be prestressed in themselves, so enabling longer spans to be used.

(3) Strutting and shuttering on site would be reduced to a minimum.

(4) The prestressing together of these units while in position on the steel beams would enable the resulting composite section to function under both positive and negative bending moments, cause the precast sections to grip the shear connectors and also prevent relative movement between the units under uneven loading.

As will be seen from the necessarily brief description given, composite slab and steel beam construction has possibilities as a design technique and is perhaps the aspect of composite construction most developed yet.

However, materials other than concrete can also be used in conjunction with steel. Consider for example a long span steel lintel supporting a brick wall. This combination could be made to function compositely in much the same way as the concrete-slab/steel-beam system that is described above, the wall being considered acting as a deep and narrow compression flange. Shear connectors welded to the joist would be spaced to fit into the mortar joints.

Timber and steel too offer possibilities. There is, of course, the well-known flitched beam, in which a steel plate is sandwiched between two timber members, the whole being bolted together to act as a unit. But apart from this classic example of composite construction, there is a large field waiting for development, such as shell roof construction, particularly some form of laminated timber shell. In the case of barrel vaulting maximum economy can be achieved if such a shell is supported on steel columns and transverse stiffening beams. There may even be a case for steel edge and valley beams in certain circumstances. But the type of shell roof which, in the writer's opinion, offers the greatest scope for timber and steel in combination is the hyperbolic paraboloid. The forces in this type of roof are small, but generally full advantage cannot be taken of this fact owing to the danger of buckling. If, however, a thin plywood membrane is stiffened by light steel sections in the form of a network, this would not only increase the load required to buckle the shell, but would also simplify the problem of jointing adjacent plywood panels. The stiffening ribs would run parallel to the edge beams, and would, therefore, be straight.

In conclusion, and as a summary, it may be said that significant economies are sometimes possible in structural design by incorporating composite action in one form or another. It is a form of construction which, though rather neglected, has great possibilities.

Road-Rail Plan for Copenhagen

A combined road and rail plan has been put forward for Copenhagen, involving a system of two-level tunnels with rail above and rail below. The road section of the tunnel would normally provide four carriageways, occasionally widened for bus stops and lay-bys for damaged vehicles. In the lower half of the tunnel, provision would be made for four tracks, two for rail and two for trams; the tunnel profiles and curves would be selected to accommodate both trains and trams but it is intended that the trams shall be dispensed with as soon as sufficient links have been established between the new tunnels and the existing suburban rail system.

The plan is described in detail in a booklet published by the Royal Danish Automobile Club under the title *Tunneler for Gade- og Skinne-Trafik under Københavns*. Though in Danish, there is a lengthy English summary which, together with the illustrations, gives a good idea of the scope of the project.

Greater Copenhagen now has a population of over 1,340,000 and the number is increasing fast. Within the city conditions for traffic are rapdily becoming impracticable, the capacity of the streets falling far short of the demands of modern motor traffic. Parking conditions within the city have also become impossible.

With the growth of population too, the average distance between home and place of work is getting greater so that the increase in traffic is even more marked, particularly in respect of individual transport by car.

The proposed plan calls initially for two tunnels under the centre of the city crossing nearly at right-angles. One of these tunnels is about 450 metres long and will connect Noerreport, the busiest point on the existing rail system, with the most northerly of the three bridges that cross the harbour; the alignment of this tunnel would be roughly northwest to southeast. The second tunnel, running from southwest to northeast, is 1,350 metres long and would connect the main station and the City Hall Square with the Borgergade on the other side of the city. This tunnel could be extended at a future date towards the east to the commercial harbour and the maritime links with the provinces. It might also be extended to the southwest under the main station so that there could be direct access from the tunnel to the platforms by staircase.

This main artery through central and western Copenhagen, passing as it would under the old, the new and future areas of the city, would also be crossed and linked with an existing tunnel carrying the fast traffic along the edge of the lakes. The total length of tunnels proposed in the plan is about two kilometres.

Among the advantages to be gained by the proposals is the complete freeing of the future city areas from fast through traffic at road level, though there would be good connections to the city centre. It would also be possible to take up most of the old surface tram lines and, when the necessary rail connections have been made, all the tram services would be replaced by rail services operating below ground through the new tunnels.

The construction of the tunnels would also make it easier to establish a number of parking areas, both above and below ground, in the centre of the city and in the inner suburbs.

Finding Out More About Canada's Permafrost

Permafrost is the subject of a questionnaire, prepared by the Northern Building Section, Division of Building Research of the National Research Council of Canada, now being circulated in Northern Canada with the object of supplementing present knowledge on the distribution and occurrence of perennially frozen ground, or " permafrost " as it is commonly called.

The word permafrost is used to describe that part of the earth's crust where the temperature is below 32° F. The term describes only the thermal condition of the ground and not its composition, which may be bedrock, gravel, sand, silt, clay or muskeg, singly or in combination. During the summer, the heat of the sun thaws a layer of ground above the permafrost. This thawed layer, sometimes called the " active " layer, varies in thickness from a few inches to a few feet. It freezes again in the winter.

The existence of permafrost is of interest to both the earth scientist and to the civil engineer. To the former, the phenomenon raises a number of puzzling geothermal questions; to the latter it becomes a matter of concern wherever the frozen material is a water-bearing silt or clay, because its presence can have serious consequences for engineering work. Though the ground is solid when frozen and provides in that state an excellent bearing for a structure, it may lose its strength when thawed to the extent that it will not support even relatively light loads. Under such circumstances, settlement of the structure may well occur and, because the thawing is in many cases not uniform, the result is often differential settlement with subsequent damage to the structure.

About one-half of the land area of Canada is underlain by permafrost. The southern limit has not been determined accurately but it is believed to follow roughly the 60° parallel, dropping south of this east of Alberta to about the south shore of Hudson Bay and cutting north again across Quebec and Labrador. The southern limit is not a well-defined line but a transition zone.

Appreciating the widespread existence of permafrost, the Division of Building Research has been conducting permafrost investigations since 1950 as part of its contribution to the progress of building in Canada. Mapping the distribution of permafrost in Canada is one phase of this study. In its continuing search for a better understanding of permafrost distribution, the division has gathered information from a variety of sources including the technical literature, reports from others operating in permafrost areas, and from direct field observations such as recording soil temperatures. Emphasis has been placed on determining the southern limit of permafrost, but observations from the entire permafrost region are also being recorded. Sufficient information has been collected to permit a map to be drawn showing the approximate southern limit.

The questionnaire is in the form of a six-page folder and starts with a map of the location of the approximate southern fringe of permafrost in Canada. An introductory note on permafrost discusses the nature of permafrost; where it is to be found; and factors that affect permafrost. Ten questions are listed about various aspects of permafrost, including requests for information on vegetation, soils, depth to permafrost, and its distribution.

This questionnaire is being circulated throughout Northern Canada under the sponsorship of the Associate Committee on Soil and Snow Mechanics of the National Research Council. This Committee is responsible for encouraging and coordinating research in connection with all aspects of the ground conditions of Canada, including soil, snow and ice, permafrost and muskeg.

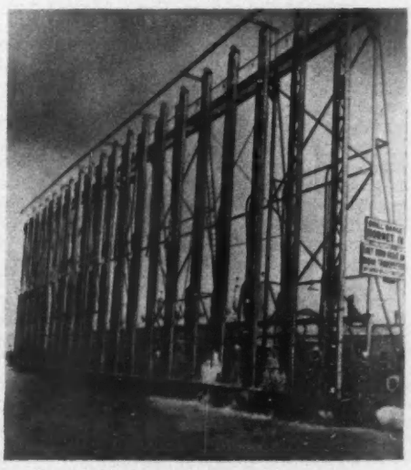
Multiple-Drill Barge for River Work

The use of batches of drills for submarine blast hole drilling in river and channel widening projects has been developed recently by the Joy Manufacturing Company in the USA. Their method involves equipping a barge with a number of drills, each powered independently by an air compressor driven by a marine-cooled diesel engine. The barge and drill " package " can be adapted for works of widely differing magnitude; considerable experience was obtained during work on the St. Lawrence Seaway.

In operation the barge is anchored over the working area where it becomes a self-contained drilling plant having a limited amount of mobility. Two cables are run out from the ends of the barge and anchored anything up to 800 ft away. By winching in cable from one end and paying out at the other, the barge can be moved to serve a particular drilling plan. Spuds, or footings, at each corner of the barge are lowered to make the rig steady during drilling.

A number of different rigs have been tried. The illustration shows a multiple-drill barge carrying 20 fixed drill towers at equal spacings. An alternative form mounts three drills, but in this case the towers are carried on rails so that forward as well as lateral movement of the drills is possible, enabling two or more parallel rows of holes to be sunk without shifting the barge. Quick acting clamps are used to fix the towers in position.

The drilling operations are carried out using a sandpipe which acts as a guide for the drill steel, prevents material from caving into the drilling and is also available for guiding the charge into the hole prior to firing. There is little basic difference between dry-land and submarine drilling, except that in the latter the hole must be loaded before the sand pipe is removed and, generally speaking, each row of holes has to be fired before the barge is moved and the next row drilled.



Barge rig with 20 fixed drilling towers.

Compact Quality Cars Will Sell Overseas

In the spectrum of motor cars there is a noticeable gap. There is no British small car of ultra high quality. The author states the case for one and envisages its design.

By John Rabson, A.M.I.Mech.E., M.S.A.E.

BRITISH car manufacturers offer as wide a range of cars as almost any other producer country, with engine sizes ranging from less than one to over six litres. With such a range it might be thought that most if not all needs were satisfied, and although this may be true up to a point, an examination of world trends indicates some gaps in the spread which could provide further potential output and useful export trade.

Interest in small cars, already noticeable in Europe before the war, has intensified during the post-war period. In England the trend was less marked; some manufacturers concentrated on cars of around 2 litres, adopting the policy of producing one car to satisfy both home and export needs—with perhaps the emphasis on the latter. This happened with some companies who had hitherto built up no small reputation as manufacturers of "eights" and "tens" as they were called under the old RAC rating. In the States, the performance race was on, with each manufacturer claiming more and more brake horsepower from engines that grew larger from season to season, to keep pace with the increased space and power that the advertisements told the customer he needed. The pendulum was swinging in both directions—reflecting the economies of the two continents. Yet now even the American manufacturers are building smaller cars, with *Ward's Automotive Reports* indicating recently that for the second quarter of 1960, over 31 per cent of that country's production would be of compact cars, which are comparable in size with European cars in the 2 to 3 litre class.

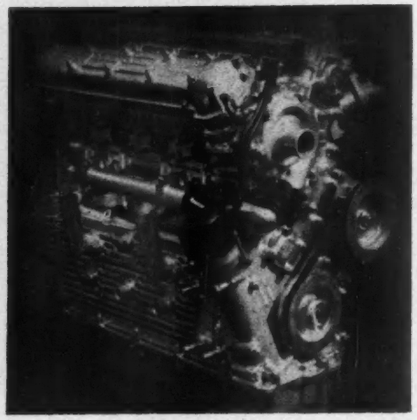
THE MISSING CAR

The general trend is towards smaller cars, but there seem to be deviations from this if quality cars are considered, at least as far as British output is concerned, and it is an interesting exercise to consider what effect this could have on both home and export markets in the future. There is undoubtedly a place for the expensive large car and also the inexpensive small one. Between these two extremes there is a range of mass-produced medium-size cars, and a handful of quality cars with engines of around 3 litres capacity or more. There are few quality cars in the 1·5 litre class.

In most countries of the world the number of car owners increases year by year, while the size of the country is fixed (this is of course one reason for the compact car—you can get more of them in a give sized jam!) but the effect could be more far-reaching. Both British and European manufacturers meet some of the requirements of the United States market in supplying a car smaller than the regular size products of Detroit and frequently occupying the role of a second car, being smaller and more compact than the home-built product. The US manufacturers, with the introduction of the compact cars, must influence this situation, and it is perhaps too early to say in exactly which direction the greatest pressure will be brought to bear.

If the American owner in the future looks upon the home-built compact car as his second car, the European export trade to that country could suffer; yet if the compact car, by reason of its smaller size, lower operating costs and ease of parking, continues to gain ground, in a few years' time it may well represent the bulk of American production, leaving the regular size cars to fill a small luxury market. If this should happen, or tend to happen, it need not affect British exports, if this country is producing the right kind of car at the right time. There is little point in buying a foreign car that is in many ways similar to a home-built one. If the first car in the family is a compact car, the second, if it is not another home-produced compact one, may well be a smaller European car, or perhaps a sports car, or a small quality car.

Europe can supply the small mass-produced car, and many examples are in production in this country and on the Continent. There is also a small band of sports cars, some of the best of which are made in England. But where is the small quality car—the high performance 1½ litre saloon, stylish, quiet, its sleek form providing express transport for up to four people, but more often only half laden?



The Coventry Climax 1½ litre engine would be an ideal power unit for the high-quality small car.

A combination of engineering and artistry, this car should appeal to that section of the motoring public which recognises efficiency and good quality. A second car for the Bentley owner could be one of its functions in this country, and forgetting the role of smaller brother, such a car would have a following in its own right. If this type of car is so attractive, why is it not produced? The answer is that there are makes in this class; at least one very successful example being produced in Italy. There are few in this country, although one manufacturer well known in the sports and racing car world produced a car pointing in this direction, but not unnaturally with perhaps more emphasis on the sporting side.

The 1½ litre quality car represents a challenge to both designer and manufacturer who are thinking to the future, as the tendency for cars to grow up (the production version having a larger engine because the performance of the prototype unit did not give the desired results) must be resisted at all costs. With a limit on engine size, weight must also be carefully controlled in the interests of performance, but the car must not be tinny or flimsy—doors which shut with an expensive clonk are to be preferred to those with a tin-can clang. Wind resistance is important: it must be as low as possible, but the car must possess a true beauty of line, and wind noise at speed must be low.

If, in terms of production quantities, the amount of business is considered to be insufficient to attract the very large producers in this country, and this may well be the case, a project of this kind might receive attention from some of the smaller manufacturers. Famous names in the industry who at present make little or no contribution to the automobile output of this country because of inability to compete in the mass-production field, might find a useful and profitable line in the 1½ litre quality car.

Both technically and commercially, the designer of such a car must resist the temptation to start with a clean sheet of paper and scheme out his new creation in such a way that all its components are completely new and special. In fact, almost the reverse must happen. He must base his design on the use of the largest number of standard bought-out parts, thereby allowing a greater amount of money to be spent on those items which must be special to a car of this kind, and which will give it its character and appeal. At the present time this should not prove too difficult. This country produces fine proprietary engines of the right size, such as the Coventry Climax illustrated, and with a fine record of development both industrially and on the race track. Therefore, with the quantities envisaged it would hardly seem worthwhile spending time and money in order to produce the power unit. Similarly, brakes, suspension units, steering and transmission components are all available.

FRONT OR REAR ENGINE?

Perhaps the greatest amount of skill and ingenuity is required in the body and chassis design, and these two items are considered together, as in fact they might well be formed as one unit structurally. In times when the mechanical components which make up a car tend to be taken for granted, to sell, a car in this class must first of all look attractive and not like an old-fashioned relation when parked next to its mass-produced half-brother. For a high rate of production, an attractive body shape usually means large sums in terms of capital expenditure on press tools, but for the quantities envisaged, large expenditure on press tools would be difficult to justify, even if the production capacity were available.

A very important point which may influence the basic layout of the car is the size of the people who are to drive it. This has a greater significance than may at first be appreciated, and is a fault found with some continental cars of high quality and very elegant line. They do not have enough head room for the six-foot male found in this country or on the other side of the Atlantic, although they may be adequate for the shorter Latin stock.

Another challenging problem is to design so that the dictates of fashion can be met, with the minimum of expense, in the form of a face-lift from time to time (and this also means visible body changes). If the engine is located at the same end of the car as its driving wheels, the elimination of the propeller shaft tunnel and the provision of a low, flat floor, enables the desired qualities of adequate head room and low overall height to be achieved, and for a vehicle of this type and class, front rather than rear mounted engine and drive is to be advocated, if for no other reason than that it permits greater luggage carrying capacity. If necessary the car can be driven with the rear locker lid open. This facility is not available with a rear engined car.

The use of resin-bonded glass fibre has already provided the solution to body production for several vehicle manufacturers producing cars in relatively small quantities, and by now vehicles so produced should have been on the road long enough to furnish necessary information regarding the fatigue life and ageing qualities of the material under normal operating conditions.

Will the low seating position made possible by the use of front-wheel drive, and glass fibre bodywork provide the answer?

Space Bound Reactors

NUCLEAR rockets launched from the earth present special shielding and operational problems. Malfunctioning of the equipment would produce some contamination hazard which, although far less than the fall-out hazard from nuclear explosions, would bring political pressure to bear against the project. But if a complete nuclear engine can first be put into orbit using chemical propellents, a relatively small power plant with little shielding will suffice to accomplish useful space missions. As the reactor would leave the ground cold, the dangers of fission-product release are eliminated. Developments in nuclear rocketry, space auxiliary power, and stratospheric applications are reported below.

Target for Space Missions

Useful nuclear rocket applications can be defined as ones that cost less than similar missions performed with chemical propellents. The two methods of propulsion break even when the required thrust is in the order of a million pounds. Smaller engine thrust can be used economically when applied to a third-stage rocket, but the problems of starting the reactor and engines in mid-flight are formidable. Hence small engines can only be used when driving space vehicles launched from an earth orbit. Under those conditions the reactor can be brought to power safely and the timing is not as critical as in third-stage applications. It may be expected that a payload of 33,000 to 60,000 lb will be delivered into a 300 mile orbit by the Saturn launcher in 5 to 10 years time. To remove a 33,000 lb space vehicle from orbit, a thrust of about 10,000 lb is required, which would produce an acceleration of 0·2 to 0·4*g*. The target for nuclear space engines is thus between 10,000 and 20,000 lb thrust. A schematic view of a nuclear rocket appears in Fig. 1.

Random or Cubic Pebble Array

Space travel is a highbrow's subject, in which only the most advanced reactor concepts are considered. As a starting point, the best high-temperature reactor material is strained to its physical limits, and the proposal of operating a graphite pebble-bed reactor at the modest temperature of 4,000 to 5,000° F emerges. To produce the required thrust, a specific impulse of 850 sec in vacuum is required, entailing a coolant flow between 10 to 20 lb per sec. At this comparatively low flow rate it is possible to utilise the pebble-bed principle without suffering from excessive pressure drop. The coolant pressure drop depends on the void fraction encountered in the core, and to a marked extent on the arrangement of the pebbles. Random packing is cheap and remains unaffected by thermal distortions. The flow-rate can be doubled by hand packing the pebbles into a cubic array at great expense. The extra costs arise from strict tolerances imposed on the pebble diameter, hand packing, additional support, and the requirement for shaped edge pieces. Thus the application of high-temperature pebble-bed reactors is limited to relatively low thrusts, that is, to space missions.

Hot or Cold End Support

There are a number of qualities that make the pebble-bed concept attractive. Fig. 2 shows a section of a proposed rocket engine of simple construction. Fuel, moderator and reflector are in the form of pebbles filling the voids between structural members separating the core into zones. The pebbles are contained in a tungsten wire basket resting on a grid or tied to the graphite plates separating the core into zones. In the latter case the load is taken up at the cold end of the reactor. Considerable internal drag would have to be resisted by the core baskets, estimated at 1·2 million pounds in the case of a space vehicle. A separate stream of hydrogen coolant is provided for the reflector zone and is used in turbines to drive the coolant pumps. As the fuel is contained in small pellets, the flux distribution can be simply controlled by varying the amount of fuel in the various core zones. Nevertheless considerable radial coolant flow will exist as a result of increased power density towards the core centre. Suitable gags would be formed to regulate the coolant flow by varying the pebble size in the top reflector.

Two Pebble Sizes Reduce Void Friction

Internal accelerations must be avoided in a space vehicle wherever possible and control rods slamming into the core are not acceptable. A suitable system that avoids inertia forces consists of a beryllium oxide drum coated with stainless steel on one side and inserted into the reflector. By turning the drum the amount of reflection and absorption in the control drum can be varied. Another control problem typical to pebble-bed reactors results from the relatively high void fraction of the core. To ensure a reasonably long neutron lifetime while using a light and thin reflector it is desirable to reduce the void fraction as much as possible without increasing the coolant pressure drop. One way of solving the problem is to use smaller size pebbles to fill the voids left by the larger ones. Using only two sizes with diameters in the ratio of 1 to 5, the void fraction can be reduced to about 30 per cent. The distribution of the small and large pellets is in the ratio of 30 to 70. If a smaller increase in neutron lifetime is accomplished by increasing the thickness of the reflector, the extra weight would require $250,000 worth of thrust to put it into orbit. (M. M. Levoy and J. J. Newguard; Nuclear Space Vehicles Using Pebble Bed Reactors, SAE National Aeronautic Meeting, April, 1960, paper 165B.)

Projecting Kiwi and Rover

The Kiwi is an Australian bird that has given up any idea of flight. It is also the name of reactors constructed by the USAEC and the National Aeronautics and Space Administration (NASA) in America's effort to develop nuclear rocket engines in stationary tests. The name of the project is Rover. It appears that component development peculiar to rocket applications takes longer than development of tests reactors. The longest lead-time is needed for cryogenic components used in the handling, storing, metering and pumping of liquid hydrogen. As early as 1956 the US Air Force started the development of a suitable pump for Project Rover, the result of which is now the biggest capacity cryogenic pump known to exist. On a different level are the high-temperature problems of

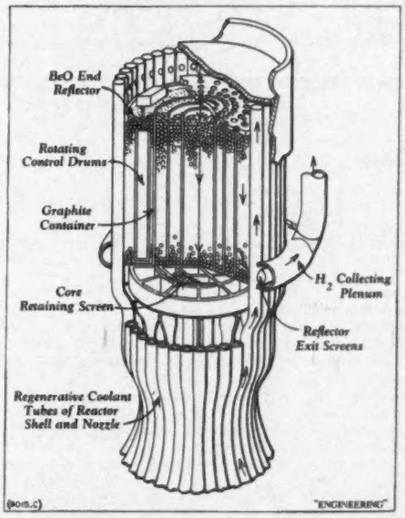


Fig. 2 Cutaway view of rocket engine.

rocket development, in particular support structures and fuel elements. The first test reactor Kiwi-A was designed for low-power operation and aimed at a duration comparable to actual flights. No provision was made for any containment of fission products, which were allowed to escape freely with the hydrogen coolant, nor was the reactor shielded. Under these conditions the safe unshielded operating distance was found to be comparable with that required by chemical rockets. (Lt. Col. H. R. Schmidt and Major R. S. Decker: The Nuclear Rocket: New Powerplant for Space Vehicle Propulsion, USAEC publication TID-8520, March, 1960.)

Vapour Pressure of Solid Moderator

Successful operation of the mercury-vapour cycle space auxiliary power source SNAP-2 was reported in Atomic Review, 18 Dec. '59. The miniature power plant was described in great detail at the

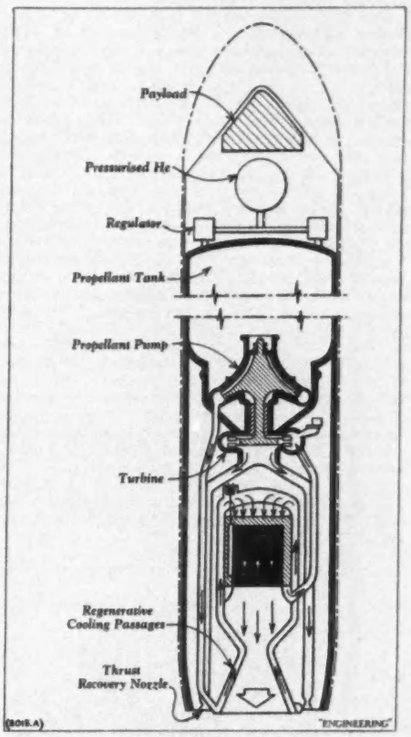


Fig. 1 Schematic view of nuclear rocket.

SAE Aeronautics Meeting in New York. There are two ways of making a light power reactor. One would use about 67 kg of pure uranium 235 in a fast core with a volume of about one-tenth of a cubic foot. Since fuel recovery is impossible, the core would be used only once, and the cost would be a million dollars. The other possibility is to use a highly rated thermal core with the most effective moderator available. Zirconium hydride was chosen for SNAP-2 in order to reduce the containment troubles arising from high vapour pressure. It is interesting to note that, even with a solid moderator, appreciable vapour pressure exists as a result of dissociation, amounting to 2·5 atmospheres at a temperature of 1,500° F. The solid homogeneous fuel elements of SNAP-2 are similar to those developed by General Atomics for their Triga series of research reactors, and have a strong negative temperature coefficient. (Atomic Review, 15 January, 1960.) The limiting quantity in the power cycle was the condenser cooling surface. To obtain reasonable performance from a small radiant cooler the final approach temperature had to be left quite large. As a result it became important to maintain the maximum cycle temperature above 1,200° F. Rankine, Brayton and Stirling cycles were considered, but the latter two were discarded in favour of the Rankine vapour cycle because heat rejection involving phase-change makes better use of the limited heat transfer surfaces available.

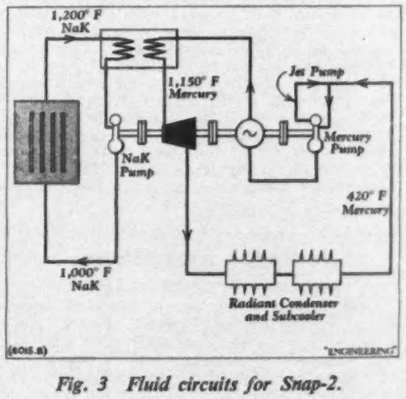


Fig. 3 Fluid circuits for Snap-2.

Handling Vapours at Zero Gravity

Two fluid loops are used, NaK serving as reactor coolant and mercury as the working fluid. The schematic arrangement is shown in Fig. 3. One of the problems associated with engines operating in space is lack of gravity, particularly objectionable in centrifugal pumps which have to operate at zero suction head. The mercury circulating pump is only 0·3 in diameter but as a result of the 40,000 r.p.m. rotational speed develops a delivery pressure of 175 lb per sq. in. A separate jet pump is used to boost the suction pressure under zero-gravity conditions. The mercury boiler is also designed to produce an artificial gravitational field by arranging the flow in a helical path and inserting additional "turbulators" in the mercury boiling section to improve heat transfer. No difficulties were experienced in the condensers where viscous forces caused adhesion to the heat-transfer surfaces. The condenser consists of straight tubes welded to radiant surfaces. A sufficiently high vapour velocity is maintained to force the condensate through the tubes. A special subcooler section is employed which reduces the mercury temperature below condensation as added protection for the pump. With completion of component testing, the SNAP-2 programme has reached a new phase in its development, and power systems suitable for flights are expected in 1963. (Lt. Col. G. M. Anderson: SNAP-2, A Reactor Powered Turboelectric Generator for Space Vehicles, SAE National Aeronautics Meeting, New York, April, 1960, paper 154B.)

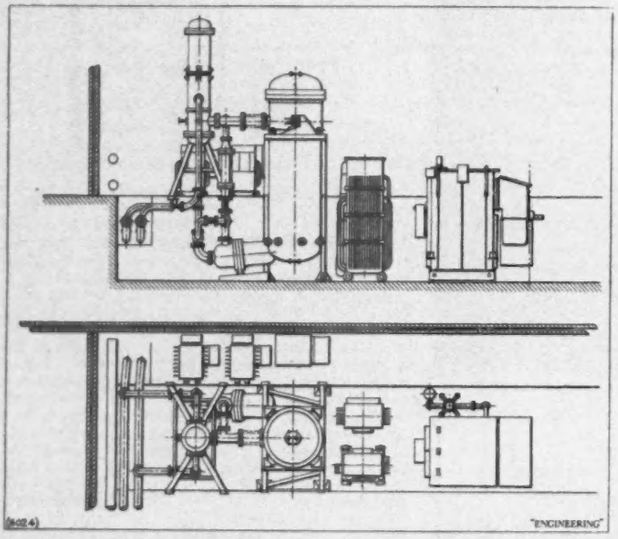


Fig. 4 A cluster of seven full sized fuel elements will be used in a test rig to be erected at the Nuclear Research Centre of C. A. Parsons and Company. High-temperature experiments will be conducted for the Dragon HTGC reactor project.

Fast Reactor for Manned Rockets

In contrast to unmanned rockets, which are not likely to return to earth for maintenance, there is a possibility that manned rockets might periodically return their fuel for reprocessing. Under such conditions a fast reactor concept is attractive because of reduced weight, while the very high fuel investment would be spread over a series of missions. Contamination of the atmosphere results if the rocket is operated at low levels from direct release of fission products from fuel elements; from the erosion of activated reactor components; and from activation of the atmosphere by neutron leakage. The crew would be shielded from direct radiation by two stages of liquid shielding. One tank would contain a heavy liquid such as mercury for gamma-ray shielding, which could be pumped into parts of the space station where personnel entry is required. The other tank would contain borated chemical fuel for neutron shielding. The fuel would be used in retrorockets for atmospheric reentry and landing when the reactor is shut down. (H. F. Crouch: Nuclear Rockets for Lifting Manned Stations into Space, SAE National Aeronautics Meeting, New York, April, 1960, paper 167A.)

Notes and News

High Temperature Experiment for Dragon

Using a cluster of seven full sized fuel elements heated electrically, the Dragon Project reactor experiment allows a detailed study of the mechanical and thermodynamic properties of the proposed high-temperature core under operating conditions of coolant flow, pressure, temperature and heat rating. The plant will be erected in the heat laboratory of the Nuclear Research Centre of C. A. Parsons and Company. The experimental circuit shown in Fig. 4 comprises the reactor vessel, the cooler and the blower, and has been laid out to contain the cooling gas at a pressure of 600 lb per sq. in. The pressure vessel has a diameter of 5 ft and a height of 18 ft and is designed for a temperature of 350° C. A cylindrical cradle, suspended near the top of the pressure vessel, carries at its lower end a grid supporting the seven fuel elements surrounded by the graphite reflector of approximately 3 ft diameter and 8 ft height. The cooler is a gas-to-water shell-and-tube design incorporating a by-pass on the gas side to achieve flexibility of temperature conditions. The coolant motor and blower unit is completely enclosed within a separate pressure vessel and has a single overhung centrifugal impeller with gas-lubricated journal and thrust bearings. The shaft is driven by a 3-phase synchronous motor supplied from an infinitely variable high-frequency converter. Further control of the flow conditions is obtained by a by-pass to the blower.

Variable Thermal Gradient

To simulate reactor conditions in the six outer fuel elements, these are connected to a 5 MVA transformer which has a 39 position on-load tap-change control, whereas the six outer rods of the centre fuel element are connected to a 500 kW and the centre rod of this element to a 100 kW infinitely variable transformer. The design of a suitable electrical heater for the fuel elements was largely governed by the high heat rating of the fuel and the sheath temperature of about 1,000° C. This limited the design to radiant graphite heaters which are undergoing long-term tests in a specially designed rig. Another subsidiary test rig allows for the examination of a fully instrumented prototype fuel element under operating conditions. The overall thermodynamic performance of the core will be compared with that predicted from heat-transfer tests on single fuel elements. Tests will involve the measurement of mixed mean inlet and outlet temperatures, mass flow, surface temperatures and heat input over a range of operating conditions. Fault conditions of the reactor will be simulated by appropriately reducing flow rate and heat flux level. Mechanical failures of the fuel elements or core assembly from vibrations will also be analysed. To obtain final reactor operating data, long-term experiments will be carried out with helium controlled by a plant capable of maintaining the amount of impurities at a very low level. The equipment will be commissioned by the end of 1960.

Industry Forces UKAEA's Back to the Wall

In negotiating for a five year contract to supply unspecified chemicals to the Atomic Energy Authority, a company has secured a minimum first year profit of 17 per cent, rising to 45 per cent in the final year of the contract. The manufacturer in question is now the only supplier of the chemical in the United Kingdom, and claims that high returns are justified because on expiration of the contract there is little prospect of future commercial exploitation. It is interesting to note that at the end of the contract period the manufacturer will have supplied the chemical to the Authority for 15 years without interruption. It is difficult to imagine a commodity which the Authority needs for 15 years on an increasing scale, and then reduces purchases to zero. When the contract comes for renegotiation in 1964, the situation will be unchanged: the Authority will need the chemical and the manufacturer will have a guaranteed monopoly.

Euratom in Charge of Nuclear Foreign Policy

France, a member of Euratom, completed a private agreement with the Soviet Union for the exchange of information on the peaceful uses of atomic energy during Mr. Khrushchev's pre-summit visit to Paris. Under the terms of the Euratom agreement, member countries are obliged to disclose all information on the peaceful applications of atomic energy. Under attack from other Euratom countries, the Commissariat a l'Energie Atomique (CEA) has given M. Etienne Hirsch, chairman of the Euratom Commission, written assurance that all information received from the Soviet Union would be passed on. The move makes private agreements between Euratom members and other countries on the exchange of information meaningless, and should make Euratom the sole external negotiator. Entry of the United Kingdom into Euratom will be discussed among countries of the Western European Union and the UK Government shortly.

Standardisation Key to Small Reactor Success

Visualising the time when pumps, valves and even pressure vessels can be supplied off the shelf, Mr. John A. McCone, chairman of the USAEC, pointed to extensive standardisation of nuclear components as a key to the success of small reactor stations. Mr. McCone was addressing the American Public Power Association convention on 5 May. Other important developments are increased core rating—raised from 60 to 150 MW in the case of Shippingport without any increase in size—reduced fuel charges and improved steam conditions. In spite of the extensive electrical grid in existence, Mr. McCone said that "enormous numbers of consumers in the United States obtain their power from relatively small plants of the order of 20 to 50 MW."

Plasmoids May Solve Thermonuclear Containment

An alternative approach to the problems of containing the plasma of a thermonuclear device has been described by Professor Dennis Gabor of Imperial College. Working with intense electric arcs discharged in the presence of magnetic and electric fields, it was observed that a very high circulating current is established in a flattened arc. If the arc is in a very low pressure gas, the circulating current may exceed the current of the arc by a factor of 100. Previously it was discovered by W. H. Bostick in America that sections of plasma could be removed from the arc, and that they would exist independently for short periods. Bostick called such pieces of plasma "plasmoids." Professor Gabor suggests that toroidal plasmas produced in the flattened arc might be removed in a similar fashion, and that the plasmoids would continue to carry the high circulating current. The effects would be very similar to that produced in toroidal pinch devices such as Zeta, but would require no containment and the purity of the plasma could be maintained with less difficulty. Professor Gabor, in his article "Inventing the Future" (*Encounter*, May, 1960) emphasises that the experiments are still very far from fusion application, but reasserts that "the fusion problem can and will be solved, and that the thermonuclear generators of the future will have to be the biggest and boldest machines ever devised."

Reactor Notes

Submarine for the Royal Navy: Construction of a second nuclear submarine has been confirmed during the debate on Naval estimates in the House of Lords. The launching date for Dreadnought has been set for 21 October.

AEC and AEA Confer: Sir Roger Makins, chairman of the UKAEA, is in Washington for discussions with representatives of the USAEC and the State and Defence Departments.

NDA and GMC Cooperate: General Motors Corporation and Nuclear Development Corporation of America have been selected as contractors for a 2 to 3 MW(e) mobile military power plant.

Bids for Advanced BWR: The USAEC has received four bids to supply, and two bids to operate a prototype advanced boiling-water reactor of 50 MW(e) capacity.

Contract for Demonstration BWR: General Electric Company and Consumers Power Company of Jackson, Michigan, have been selected as supplier and operator for the 50 MW(e) boiling-water demonstration plant, to be erected at Big Rock Point, Michigan.

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The terms and conditions of appointment may be obtained from the undersigned, with whom applications (twelve copies), giving the names of three referees and including any testimonials or evidence candidates may wish to offer, should be lodged not later than 30th June, 1960. A candidate from overseas may submit one copy of his application.

CHARLES H. STEWART,
Secretary to the University.

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Applications are invited from those suitably qualified to fill the post of ASSISTANT CHIEF ENGINEER (GENERATION) with the CENTRAL ELECTRICITY AND WATER ADMINISTRATION, KHARTOUM, THE SUDAN. Applicants should hold a University degree in Engineering and/or be Corporate Members of the Institution of Mechanical Engineers or the Institution of Electrical Engineers. They should have had considerable experience in design and construction of large diesel power stations. Duties include responsibility for preparing layouts and specifications covering complete installations, including electrical equipment. A knowledge of modern steam plant will be of considerable advantage.

Appointment will be on contract for a period of five years, the first twelve months being a probationary period. Salary offered is £82500 per annum, plus a variable cost of living allowance which is at present £8187 per annum. An initial outfit grant of £850 is payable on appointment. (£81 equals £1 0s. 6d.)

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Applications are invited for the post of

SENIOR LECTURER in PRODUCTION ENGINEERING

Applicants should be well qualified technically and professionally and have held a responsible position regarding some aspects of production engineering technology in industry. Experience in development work and experimentation is desirable with ability to develop subjects such as Machine Tools, Metrology and Tool Engineering and other production engineering technology to a high level.

Salary scale: Senior Lecturers (men) £1550 to £1750.

Further particulars and forms of application from the Bursar, College of Advanced Technology, Gosta Green, Birmingham 4. Applications to be received within 14 days of this advertisement.

K. R. PILLING,
Clerk to the Governors. C 195

CITY OF BIRMINGHAM
EDUCATION COMMITTEE
ERDINGTON TECHNICAL COLLEGE
EDWARDS ROAD, BIRMINGHAM 24

Principal: G. GREASLEY, D.I.C., M.I.E.E., A.M.I.Mech.E.

ASSISTANT, GRADE A, with suitable qualifications required at end of September to teach Engineering subjects up to Ordinary National Certificate level.

Salary scale: Assistant, Grade A, £520 by £27 10s. 0d. to £1000. When assessing the initial salary, increments may be allowed for appropriate experience in industry, in addition to increments for training, approved qualifications and experience.

Application forms and further particulars available from Principal.

E. L. RUSSELL,
Chief Education Officer. C 196

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH and DEVELOPMENT DEPARTMENT

Research Laboratories, Leatherhead, Surrey

FLUID DYNAMICS SECTION

ENGINEERS AND PHYSICISTS are required for the newly formed **FLUID DYNAMICS SECTION** that will cover a wide range of problems, including the accurate measurement of large flows of liquid and gases in power stations; model investigations of the flow pattern near closely grouped cooling towers, detailed studies of the flow in tube banks of heat exchangers and in fuel element channels of nuclear reactors, the distribution of pulverised coal to the burners of power station boilers, etc., and there is ample scope for both fundamental and applied research.

Candidates for senior vacancies should have an honours degree and previous research experience in fluid dynamics; for the other vacancies applicants should have a degree, or equivalent, and some experience in a related field is desirable. Applications from recent graduates, and students who expect to graduate this year, will be welcomed.

Salaries on scales within the range £1,195-£1,775 p.a., or £570-£1,300 per annum, according to duties and responsibilities.

There are good opportunities for promotion to higher grades. Where necessary, consideration may be given for financial assistance towards house purchase.

Applications stating age, qualifications, experience, present position and salary, to the PERSONNEL OFFICER, 24/30, HOLBORN, LONDON, E.C.1., by 30th June. Envelopes should be marked " Confidential Ref. ENG./199." C 209

HOSPITAL DESIGN ENGINEERS

EXPANSION OF BUILDING PROGRAMME

NORTH WEST METROPOLITAN REGIONAL HOSPITAL BOARD

PROFESSIONAL ENGINEERS

required for the staff of the Regional Engineer,

JAMES GALLOWAY, M.I.Mech.E., M.I.E.E., M.I.H.V.E.

The posts are permanent and pensionable and offer considerable career prospects owing to the vast expansion of the hospital building programme. Those appointed will be members of a team designing the engineering services for new hospitals, extensions, etc.; they will work under the general control of an experienced professional engineer, but they will themselves be responsible for the design and management of individual schemes. The work is complex in nature and extremely interesting and offers a challenge to the engineer who wants more than the usual run of job.

Applicants should be A.M.I.Mech.E. or A.M.I.E.E., or A.M.I.H.V.E., but graduate members of these Institutions will be accepted provided that in the case of the Institution of Heating and Ventilating Engineers they have passed Sections A and B of the Institution examination.

SALARIES will be within the range of £910 to £1600 plus £40-£50 London Weighting. The minimum point of entry for Corporate Members of the major institutions is £1160 plus £50 London Weighting. A bar exists at £1400 plus £50 beyond which it is necessary to be A.M.I.Mech.E. or A.M.I.E.E., and graduates do not proceed beyond £1205 plus £50 until they have obtained Corporate Membership when continuance up the scale is automatic.

It is expected that these posts will be accepted by the professional institutions as leading to Corporate Membership provided other conditions have been fulfilled. A scheme for study leave is in process of inauguration.

APPLY, stating age, qualifications (with dates) and experience, with names of two referees, to the Secretary, North West Metropolitan Regional Hospital Board, 40 Eastbourne Terrace, London, W.2, quoting reference 823. Enquiries by telephone or visit by appointment to the Board's headquarters offices would be welcome. Tel.: AMBassador 8011, Ext. 330.

C 139

AUSTRALIA

THE UNIVERSITY OF NEW SOUTH WALES

VACANCY FOR PROFESSOR OF MECHANICAL ENGINEERING

The University invites applications for appointment to a newly created CHAIR OF MECHANICAL ENGINEERING in the SCHOOL OF MECHANICAL ENGINEERING.

Salary will be £A4250 per annum.

The present professorial staff comprises the Head of the School, Professor A. H. Willis, a Research Professor and two Associate Professors.

The successful applicant will be expected to take an important part in the administration and development of the School and to promote research and post-graduate study in his chosen field.

The University will commence, in 1961, new buildings for the School of Mechanical Engineering at Kensington which should permit a large expansion in both its teaching and research activities.

Subject to satisfactory medical examination, Professors will be eligible to join the Superannuation Fund which provides a maximum pension of £A2184 per annum.

Professors are eligible for six months' study leave on full salary after three years of service, or twelve months after six years of service. Subject to the consent of the Council of the University, Professors may engage in a limited amount of higher consultative work. With the approval of the University and its bankers, married men may be assisted by loans to purchase a home.

First class ship fare to Sydney of appointee and his family will be paid.

The University reserves the right to fill the Chair by invitation.

Four copies of applications, together with the names of three referees and a copy of a recent photograph, should be lodged with the AGENT GENERAL FOR NEW SOUTH WALES, 56-57 STRAND, LONDON, W.C.2, and a copy forwarded in an envelope marked " University Appointments " to the BURSAR, THE UNIVERSITY OF NEW SOUTH WALES, BOX 1, POST OFFICE, KENSINGTON, NEW SOUTH WALES, AUSTRALIA, not later than 30th JUNE, 1960. C 191

THE UNIVERSITY OF MANCHESTER

Applications are invited from graduates in Physics, Chemistry, Metallurgy, Biology or Engineering for the post of ASSISTANT LECTURER IN DENTAL MATERIALS. The person appointed will be concerned with work on the properties of dental materials. Applications would be considered from persons intending to graduate in 1960. There is wide scope for research in this field and ample facilities are available. Salary on a scale (at present under review) £700 to £850 per annum with membership of F.S.S.U. and Children's Allowance Scheme.—Applications should be sent not later than JUNE 18th, 1960, to the REGISTRAR, THE UNIVERSITY, MANCHESTER 13, from whom further particulars and forms of application may be obtained. C 200

LONDON COUNTY COUNCIL

WANDSWORTH TECHNICAL COLLEGE

WANDSWORTH HIGH STREET, S.W.18

Required in September owing to expansion of work:—

FOUR LECTURERS to teach

(i) and (ii) TO H.N.C. ELECTRICAL ENGINEERING STANDARD. Experience in electrical power or measurements or Electronics and Transistors an advantage.

(iii) METALLURGY to H.N.C. and Degree Standard.

(iv) APPLIED PHYSICAL CHEMISTRY and EXTRACTION CHEMISTRY to H.N.C. (Metallurgy) Standard.

TWO ASSISTANTS, GRADE B, to teach

(i) APPLIED PHYSICS to advanced students in metallurgy and engineering courses.

(ii) MATHEMATICS to H.N.C. standard.

For all posts, graduate or equivalent qualification required. Industrial and teaching experience desirable.

Burnham (F.E.) salary scales: Lecturer, £1370 by £35 to £1550 plus London Allowance. Assistant, Grade B, £700 by £27 10s. to £1150 plus London Allowance and additions for qualifications and training. Increments within scale for approved experience.

Application forms from SECRETARY AT COLLEGE, to be returned by JUNE 24, 1960. (1321) C 201

TEACHER FOR ELECTRICAL ENGINEERING SUBJECTS

TEACHER FOR ELECTRICAL ENGINEERING SUBJECTS to teach mainly Electrical Installations Work with some Electro-technology for the Ordinary National Certificate Scheme. Candidates to have National Certificate or City and Guilds qualifications. Salary: Burnham Technical Scale, Grade A, £520 by £27 10s. 0d. to £1000 per annum, plus London Weighting.

Applications (no forms) should be sent with the names of two referees, and not more than two testimonials to THE PRINCIPAL, SOUTH HERTS COLLEGE OF FURTHER EDUCATION, WOOD STREET, BARNET, HERTS. C 211

CARMARTHENSHIRE EDUCATION COMMITTEE

AMMANFORD TECHNICAL COLLEGE

DEPARTMENT OF ENGINEERING AND MINING

Applications are invited for the post of full-time LECTURER in ELECTRICAL ENGINEERING at the above named Technical College.

Candidates should be graduates in Electrical Engineering with suitable industrial experience. Teaching experience in a Technical College will be an added recommendation.

Salary in accordance with the Burnham Further Education Report, 1959 (£1370 to £1550) for Lecturers.

Duties to commence on 1st September, 1960, or as soon as possible.

Application forms, which must be returned not later than 11th June, 1960, may be obtained from the undersigned on receipt of a stamped addressed envelope.

IORWERTH HOWELLS,
DIRECTOR OF EDUCATION.

COUNTY EDUCATION OFFICES,
COUNTY HALL,
CARMARTHEN. C 119

THE UNIVERSITY OF MANCHESTER

Applications are invited for the post of LECTURER IN NUCLEAR ENGINEERING. Candidates should be graduates in engineering or physics; experience of experimental reactor physics or heat transfer would be an advantage. The successful candidate will take part in teaching and research in the Nuclear Engineering Laboratory. University regulations permit teaching staff to read for the degrees of M.Sc. and Ph.D. Applications will also be considered from engineers and physicists who would be interested in a temporary appointment of two or more years. The salary scale is £1050 to £1850 per annum. Membership of the F.S.S.U. and Children's Allowance Scheme. Initial salary according to qualifications and experience.—Applications should be sent not later than June 18, 1960, to the REGISTRAR, THE UNIVERSITY, MANCHESTER 13, from whom further particulars and forms of application may be obtained. Applications by airmail letter in the first instance will be considered from overseas candidates. C 214

ROYAL TECHNICAL COLLEGE, SALFORD

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for appointments in this College of Advanced Technology as

LECTURERS IN MECHANICAL ENGINEERING

Applicants should have an honours degree or equivalent in engineering or applied science, and industrial, research or teaching experience. The persons appointed will be expected to carry out research in mechanical engineering for which excellent facilities exist. Subject to reasonable safeguards, staff are encouraged to engage in consulting work for industry. There are good prospects of further advancement.

These posts offer excellent opportunities to take part in the development of Technological Education in the present important phase of its growth.

The salary scale is £1370, rising to £1550 p.a. Appointments may be made at appropriate points.

Further particulars and forms of application may be obtained from the REGISTRAR, ROYAL TECHNICAL COLLEGE, SALFORD 5, LANCS, to whom completed forms must be returned by 11th JUNE, 1960. C 205

CITY OF SHEFFIELD EDUCATION COMMITTEE

COLLEGE OF TECHNOLOGY

Required to commence duties in September next:

DEPARTMENT OF ENGINEERING

LECTURER IN ENGINEERING MATHEMATICS to teach Mathematics to Ordinary National Certificate and Higher National Certificate students. Interest in teaching statistics and computation will be welcomed. Ability to develop a Mathematics laboratory would be a recommendation.

ASSISTANT (GRADE B) IN MECHANICAL ENGINEERING (2 POSTS) to teach mainly in part-time day Ordinary National Certificate classes a selection from engineering science, applied mechanics, engineering drawing, workshop technology (production processes), mathematics and applied heat. More advanced teaching will be available for a suitably qualified or experienced teacher.

ASSISTANT (GRADE B) IN MOTOR (AUTOMOBILE) ENGINEERING to take classes in motor vehicle technology, calculations, science, drawing and garage practice for motor vehicle mechanics and motor vehicle technicians.

Salary Scales: Lecturer, £1370 by £35 to £1550 per annum. Assistant (Grade B), £700 by £27 10s. to £1150 per annum, with appropriate additions for degree and training.

Application forms, obtainable from the undersigned (s.a.e.) at P.O. BOX 67, SHEFFIELD, 1, should be returned within fourteen days of the appearance of this advertisement.

T. H. TUNN,
Director of Education. C 213

LABORATORY TECHNICIAN

LABORATORY TECHNICIAN required for the electrical and mechanical laboratories and to give some assistance in the workshops. O.N.C. or C. & G. qualifications desirable. Salary £525-£655 (A.P.T.C. Misc. III/IV), Local Government conditions and superannuation. Three weeks holiday per annum. Facilities for further education.—Apply: PRINCIPAL, SOUTH HERTS COLLEGE, WOOD STREET, BARNET. C 210

ROYAL TECHNICAL COLLEGE, SALFORD

DEPARTMENT OF

MECHANICAL ENGINEERING

Applications are invited for appointments in this College of Advanced Technology of SENIOR LECTURERS in

(*a*) MECHANICS OF MACHINES
(*b*) STRENGTH OF MATERIALS
(*c*) PRODUCTION ENGINEERING

Applicants should have an honours degree, or equivalent, in engineering or applied science, and industrial, research or teaching experience. Applicants for post (*a*) should preferably have had experience in mechanical vibrations or control systems; for post (*c*) research or industrial design experience in machine tools or related topics would be of advantage.

The persons appointed will be expected to take a leading part in the teaching of their subjects in the Department and to carry out research, for which excellent facilities exist. Subject to reasonable safeguards, staff are encouraged to engage in consulting work for industry.

These posts offer excellent opportunities to take part in the development of Technological Education in the present important phase of its growth.

The salary scale is £1550 p.a., rising to £1750 p.a. Appointments may be made at appropriate points. Exceptional candidates may be considered for appointment as a PRINCIPAL LECTURER in the salary range £1750 p.a., rising to £1900 p.a.

Further particulars and forms of application may be obtained from the REGISTRAR, ROYAL TECHNICAL COLLEGE, SALFORD 3, LANCS, to whom completed forms must be returned by 11th JUNE, 1960. C 206

THURROCK URBAN DISTRICT COUNCIL

(ENGINEER AND SURVEYOR'S DEPARTMENT)

APPOINTMENT OF RESIDENT ENGINEER

Applications are invited for the above appointment for which experience of supervising construction of sewers and road improvement schemes, including setting out and measuring for Certificates of Payments, is required. Salary—£1200 p.a.

Applicants should be qualified by the examination of the Institutions of Municipal or Civil Engineers and HOUSING ACCOMMODATION MAY BE CONSIDERED BY THE COUNCIL SHOULD THE SUCCESSFUL CANDIDATE LIVE MORE THAN 20 MILES FROM THURROCK.

Subject to satisfactory service, a period of at least two years employment can be assured.

Applications, suitably endorsed, stating age, qualifications and experience, and quoting two referees, should reach the undersigned by not later than Tuesday, 7th June, 1960.

Canvassing disqualifies. Relationship with Members or Senior Officers of the Council must be disclosed.

A. E. POOLE,
CLERK OF THE COUNCIL.

COUNCIL OFFICES,
GRAYS,
ESSEX. C 184

STATION ENGINEERS

AIR MINISTRY require STATION ENGINEERS (G.D.) and STATION ENGINEERS (MECH.) at R.A.F. and Ministry of Aviation Stations. The work of Station Engineers (G.D.) consists of installation, operation and maintenance of high and medium voltage electrical distribution systems, electrical power and lighting installations, control systems and generating plant: knowledge of heating and ventilating plant and diesel engines an advantage. Station Engineers (Mech.) are concerned with diesel power plant, steam and hot water heating systems, refrigeration and air conditioning and miscellaneous workshop plant, tools and equipment. Candidates must hold O.N.C. Elec. or Mech./City and Guilds Electrical Technicians Certificates/2nd class M.O.T. Certificate or equivalent and must also have had recognised apprenticeship with firm of good repute plus 3 years' employment in electrical or mechanical and engineering preferably on operation and maintenance of mine, factory or workshops plant and services. Preference to candidate with supervisory experience.

Salary ranges from £680 to £785 rising by annual increments to £850. Commencing salary dependent upon age, qualifications and experience. Opportunities for promotion up to Tech. Grade A, maximum salary £1565 (National rate). Pension prospects. 5-day week. 18 days paid leave a year initially. Internal training courses are provided and attendance at technical colleges by suitable candidates is sponsored. Overseas tours for which special allowances are payable in addition to higher salary. Applicants, who must be natural born British subjects up to age 55, should write stating age, qualifications and experience, to MANAGER (P.E.1), MINISTRY OF LABOUR, P. & E. REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, E.C.4. No original testimonials should be sent. Only applicants selected for interview will be advised. G 885

LECTURER

UNIVERSITY COLLEGE LONDON (Gower Street, W.C.1) requires LECTURER to take charge of metallurgical teaching and research in Department of Mechanical Engineering from 1st OCTOBER, 1960. Initial salary up to £1350, plus £60 London Allowance, p.a. Superannuation and family allowance.—Applications, to be received by 18th JUNE, 1960, should be sent to the SECRETARY, from whom further particulars may be obtained. C 230

BUCKINGHAMSHIRE EDUCATION COMMITTEE

SLOUGH COLLEGE OF FURTHER EDUCATION

(Principal: R. EDGAR, M.Sc., M.A.)

Required for September, 1960, or as soon as possible thereafter, GRADE B ASSISTANT IN MECHANICAL ENGINEERING to teach mainly up to O.N.C. S2 level in Drawing and Engineering Science. Ability to teach to S3 would be helpful and training or experience (part-time or full-time) in teaching desirable.

Salary for a man will be on the scale £700 to £1150 per annum with additions for qualifications and training and with increments on the scale for previous teaching and industrial experience where appropriate.

Application forms and further particulars may be obtained from THE PRINCIPAL, WILLIAM STREET, SLOUGH, and completed forms should be returned to him by the 10th JUNE, 1960. C 220

LONDON COUNTY COUNCIL

HACKNEY TECHNICAL COLLEGE, DALSTON LANE, E.8, require, SEPTEMBER, 1960, suitably qualified evening teacher for National Certificate Workshop Technology (S.3).—Applications (no forms) to SECRETARY stating age, qualifications, industrial experience, teaching experience (if any) and evenings available from 7 to 9.15 p.m. Rate of Pay: 2¼ hours—58s. 3d. an evening. (1360) C 226

STRUCTURAL STEELWORK

BURSARIES

at

IMPERIAL COLLEGE

Applications are invited for BURSARIES for a course in ADVANCED analysis and design of Structural Steelwork.

The value of the Bursaries, normally tax free, is from £475 to £775 for the period from October, 1960, to July, 1961.

Applications should be made by 15th JUNE, 1960, to: THE REGISTRAR, IMPERIAL COLLEGE, LONDON, S.W.7, from whom further particulars may be obtained. C 218

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS

AIR MINISTRY require ASSISTANT MECHANICAL and ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1095 at 34 or over, thereafter rising to maximum of £1260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. 5-day week with 4 weeks 2 days leave a year initially. Special allowance in addition to salary during overseas service. Qualifications and experience:

(i) (*a*) University degree or equivalent diploma in electrical and/or mechanical engineering with at least 2 years' apprenticeship;
or (*b*) Graduate or corporate member of I.E.E. with at least 3 years' apprenticeship;
or (*c*) Graduate or corporate member of I.Mech.E., appreciable electrical engineering experience with at least 3 years' apprenticeship;
and (ii) Have been employed for minimum of 2 years with well established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45. Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (E), 26 KING STREET, LONDON, S.W.1, quoting D 158/OA. C 99

WORKS MANAGER

(Mass Production)

A major light engineering Company invites applications from Works Managers with specialised experience of mass production, not necessarily in the engineering industry.

An essential requirement is at least 5 years experience in a top Works Management post carrying responsibility for a minimum labour force of 1000.

The ability to take immediate action to correct adverse manufacturing trends, a keen interest in method improvement and outstanding qualities of leadership and drive are also factors which will determine the success of the applicants.

The competitive nature of the business demands that the Works Manager will have to be prepared for extended periods under considerable pressure so that physical fitness and mental stability are important factors.

The rewards are good and the possibility of personal advancement exceptional.

COMMENCING SALARY £2500—£3000

APPLICATION SHOULD BE ADDRESSED TO BOX C 226
Offices of ENGINEERING

DESIGN ENGINEERS

Hardy propeller Spicer shaft busy—very. More work Engineering Division, prototypes, new products, fwd, rwd, irs, pto shafts, c.v. joints. Hair Chief Engineer almost gone, edges white. Cars, cars, lorries, railway diesels, cars, agricultural jobs, cars. U.K. big five, Inner Six, Outer Seven. Feel like one over eight. Proud to be such a universal joint.

Designers under stress (stressmen?). Slide rule sliding shows when find two more, overload cut-out.

Monthly staff, nice people, interesting work, good conditions, sense of humour, also salary.

Design experience, HNC, 25-40, pen handy? write, tell all to

PERSONNEL DIRECTOR,
HARDY SPICER LTD.,
Chester Road, Birmingham 24.

(*Apologies Sam Weller Ltd. and their copy writer Mr. Wilmot proudest Breeden moment.*)

C 217

MUDI RIVER WATER BOARD

NYASALAND

Walker's Ferry Water Supply Scheme

Applications are invited for the following appointments in connection with the above scheme:—

(*a*) **Chief Resident Engineer (One)** with administrative ability, and extensive experience in supervising the laying, jointing and testing of high pressure steel pipelines, and also in the construction of water retaining structures and pumping stations including the tinstallation and testing of plant. Applicants must be corporate members of the Institution of Civil Engineers. Tour approximately two years. Salary £2500 per annum.

(*b*) **Resident Engineers (Two)** with experience in laying, jointing and testing steel pipelines and also in reinforced concrete and building construction. Tour approximately 18 months. Salary £1600 to £1800 depending on experience.

(*c*) **Inspector of Works (Pipeline) (One)** with experience in laying, jointing and testing steel pipelines. Tour approximately two years. Salary £1200 to £1400 depending on experience.

(*d*) **Inspectors of Works (Civil Engineering) (Two)** with experience of reinforced concrete and building construction. Tour approximately 18 months. Salary £1200 to £1400 depending on experience.

Successful applicants will be required to take up their duties between 1st October, 1960, and 1st January, 1961, depending on the appointment. Free return passages between place of recruitment and Nyasaland will be provided for employees and their families, and free housing and basic furniture will be supplied. Employees will have the right to contribute to a Medical Aid Society of which the Water Board is a member. Leave will be as follows: Appointment (*a*), two weeks' local leave and six weeks' accumulative terminal leave per year of service; other appointments, two weeks' local leave and four weeks' accumulative terminal leave per year of service.

Applications, stating the applicant's age, marital status and containing full details of his experience, accompanied by two recent testimonials, should be sent, so as to arrive by 30th June, to:—

The Chairman,
Mudi River Water Board,
P.O. Box 369, LIMBE, Nyasaland C 227

Designers/Draughtsmen

CONSULTING ENGINEERS

have vacancies in their London, Reading and Burgess Hill offices for all grades in the following fields:

Mechanical, Electrical, Aeronautical,
Structural and Reinforced Concrete,
Plant, Pipework and Pressure Vessels

Pension Scheme and three weeks annual holiday after qualifying periods

NORRIS BROTHERS LIMITED

62 Church Road · Burgess Hill · Sussex

C 181

MSL *have been retained to advise on the appointment of an*

ASSISTANT DEVELOPMENT ENGINEER

for an engineering company employing about 1,000 which has pioneered the development of domestic and commercial heating and catering equipment for over a century.

The Assistant Development Engineer will have specific responsibility for the design and development of gas-fired heavy duty equipment, with wider interests in oil, steam, electrical and solid fuel appliances. He will have contacts at all levels within the company, and with users and suppliers.

Candidates must have broad general engineering experience, including design and production, and a knowledge of heating and catering installations. A B.Sc., degree or professional membership would be an asset.

Preferred age 25 to 35 years. Initial salary in the range £1,250 to £1,500 with non-contributory pension and life insurance.

Please send brief details in confidence, quoting reference F.2211, to J. G. Smith. In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment.

MANAGEMENT SELECTION LIMITED
212, West Regent Street, Glasgow, C.2. C 231

MINISTRY OF TRANSPORT

CIVIL ENGINEERS

Pensionable posts for men and women at least 25 and under 35 on 1st January, 1960 (extension for regular Forces service, Overseas Civil Service, established civil service, and temporary Government service as Civil Engineer). Candidates must have achieved Corporate Membership of Institution of Civil Engineers or passed examinations necessary for attaining such membership. Experience in road and bridge construction essential; knowledge of Highways Authorities' procedure desirable. Salary (men, London) £830-£1125 according to age, rising to £1300. Promotion prospects.—Write CIVIL SERVICE COMMISSION, 17 NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting **S/6418.** C 238

THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY

(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER)

The Governing Body invites applications for a LECTURESHIP AND AN ASSISTANT LECTURESHIP IN MECHANICAL ENGINEERING in The Manchester College of Science and Technology, with corresponding title and status in the University of Manchester.

The Department covers a very wide field in Mechanical Engineering, including Photoelasticity, Fatigue, Servomechanisms, Vibrations, Machine Tools and Production Processes and Heat Transfer. A special high level Diploma Course in Machine Tool Design, lasting two years, has just been inaugurated. A real interest in the problems of Scientific Design would be of advantage in connection with one of the posts. All members of staff are expected to undertake, assist in or supervise research for which facilities are excellent. The teaching is almost entirely confined to Graduate and Post Graduate Courses for Internal Degrees and Diplomas. Short courses for specialists in subjects of particular interest are offered each year. Salary according to qualifications and experience, in the scale £1050-£1850 (Lecturer) or £800-£950 (Assistant Lecturer). F.S.S.U. and family allowances.

Conditions of appointment and form of application may be obtained from the REGISTRAR, THE MANCHESTER COLLEGE OF SCIENCE AND TECHNOLOGY, MANCHESTER, 1. The last day for the receipt of applications is SATURDAY, 18th JUNE, 1960. C 237

LONDON COUNTY COUNCIL

WANDSWORTH TECHNICAL COLLEGE

Wandsworth Technical College requires in September ASSISTANT GRADE B to teach MECHANICAL ENGINEERING subjects with Production Engineering bias up to H.N.C. standard. Graduate or equivalent qualifications, industrial and teaching experience desirable.

Burnham (F.E.) salary scale £700 by £27 10s. to £1150 plus London Allowance and additions for training and qualifications. Increments within the scale for experience.

Application forms from SECRETARY AT COLLEGE, WANDSWORTH HIGH STREET, S.W.18, returnable by 24th JUNE, 1960 (1459) C 251

UNIVERSITY OF BRISTOL

Applications are invited for two posts as LECTURER (ONE GRADE III AND ONE GRADE II) in the DEPARTMENT OF MECHANICAL ENGINEERING. The salary scales are:—

Grade III—£800-£950 per annum.
Grade II—£1050-£1850 per annum
(according to qualifications and experience) with F.S.S.U. benefits and Family Allowance.

The duties will consist of lecturing, laboratory and tutorial work and the supervision of research projects. There are ample opportunities and facilities for personal research work in new and expanding laboratories.

Applications (including the names of two referees) should be sent not later than 17th JUNE, 1960, to the undersigned from whom further particulars may be obtained.

H. C. BUTTERFIELD,
Registrar and Secretary. C 249

WELSH COLLEGE OF ADVANCED TECHNOLOGY

Principal: A. HARVEY, Ph.D., B.Sc., F.Inst.P.

DEPARTMENT OF ENGINEERING

Applications are invited for the following posts, duties to commence as soon as possible:—

1. LECTURER IN MECHANICAL ENGINEERING. Applicants must be University graduates in Engineering, should normally be graduates or corporate members of the Institution of Mechanical Engineers and have had adequate industrial experience.
2. LECTURER IN MECHANICAL ENGINEERING WITH SPECIAL KNOWLEDGE OF MARINE ENGINEERING. Applicants should be University graduates in Engineering or corporate members of the Institution of Mechanical Engineers and should preferably hold a first class M.O.T. certificate together with at least graduate membership of the Institute of Marine Engineers.

Salary for both posts: £1370 to £1550 per annum, with placing upon the scale dependent upon experience.

Further particulars and forms of application may be obtained from the PRINCIPAL, at the College, CATHAYS PARK, CARDIFF, to whom completed forms should be returned by 17th JUNE, 1960.

ROBERT E. PRESSWOOD,
Clerk to the Governors.

CITY HALL,
CARDIFF. C 248

ROYAL TECHNICAL COLLEGE, SALFORD

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for the post of DRAUGHTSMAN.

Candidates should have had a wide range of engineering experience and training, and should have adequate academic qualifications in mechanical engineering.

Duties will include assisting in the preparation of drawings required for the teaching of Advanced Engineering Drawing and Design, and in the detailing and design of apparatus and equipment for research and for teaching purposes. The work will be interesting and of a varied character.

Salary scale: £880 p.a., rising by five annual increments to £1065 p.a. The post is pensionable.

Applications, which should give the names of two persons to whom reference may be made, should be sent to the REGISTRAR, ROYAL TECHNICAL COLLEGE, SALFORD 5, LANCS, by 18th JUNE, 1960. C 240

WILTSHIRE EDUCATION COMMITTEE

WEST WILTSHIRE AND TROWBRIDGE COLLEGE OF FURTHER EDUCATION

Applications invited from suitably qualified men to teach ENGINEERING WORKSHOP PRACTICE AND TECHNOLOGY up to the Intermediate level of the City and Guilds of London Institute as from 1st September, 1960. Ability to teach Calculations, Science and Drawing to similar levels will be an advantage. Salary scale in accordance with Burnham "A."

Further particulars and application form from THE REGISTRAR, TROWBRIDGE AND WEST WILTSHIRE COLLEGE OF FURTHER EDUCATION, COLLEGE ROAD, TROWBRIDGE, WILTS. Application forms should be returned within fourteen days of the appearance of this advertisement. C 246

MIDDLESEX COUNTY COUNCIL

SENIOR ENGINEER, APT. IV (£1110-£1265) required in County Architect's Department for design of heating hot and cold water services in County buildings. Candidates should hold appropriate professional qualifications. Established post, pensionable, subject to prescribed conditions.—Application forms (s.a.f.e.) from COUNTY ARCHITECT, 1, QUEEN ANNE'S GATE BUILDINGS, DARTMOUTH STREET, WESTMINSTER, S.W.1, returnable by 6th JULY. (QUOTE C.659E.) C 243

APPOINTMENTS OPEN

THE GLACIER METAL CO. LTD.
have a vacancy for an

ENGINEERING MANAGER

to command a group of 13 engineers, draughtsmen, tracers, and clerks, engineering the high-speed production of thin-wall bearings. The person appointed will be responsible to the Unit Manager for all engineering aspects of production. This demands continuous review of the uses to which existing machines and equipment are put, and the development of machines and equipment in the longer term. The work requires an understanding of presses, plating plant, machine tools and high speed transfer line techniques.

Requirements: Degree, A.M.I.Mech.E., or A.M.I.Prod.E.; apprenticeship or equivalent; several years experience in methods development close to production. Preferred age 27-35. Must have the capacity to lead a team of engineers, be a source of good engineering ideas, and have the ability to influence operational managers to use the best methods.

Salary: £1100 to £1650 (probably starting in the lower half).

Apply: PERSONNEL MANAGER
(Ref. 2595)
THE GLACIER METAL CO. LTD.
EALING ROAD, ALPERTON
WEMBLEY, MIDDLESEX
C 197

ASSISTANT CHIEF ENGINEER

THE HARPER PAPER GROUP, a rapidly expanding group of companies engaged in paper making, converting and merchanting requires an ASSISTANT CHIEF ENGINEER for employment in the Blackburn area. Applicants, aged 28-40, must hold either Corporate Membership of the Institution of Mechanical Engineers or an engineering degree, and should have served a recognised apprenticeship or its equivalent. They must have a good general experience in installation and maintenance of modern machinery and plant used in the paper-making industry, and a knowledge of steam-raising plant and electrical services. The person appointed will be responsible to the Chief Engineer (who is an Executive Director of the Group) and will find the work arduous but rewarding. A commencing salary in the £1200-£1400 range is envisaged —Write for application form to PERSONNEL MANAGER, ARTHUR HOLLAND, SOUTHPORT, LANCS. (Previously unsuccessful applicants should not re-apply.) C 190

DETAIL AND SCHEME DRAUGHTSMEN

Detail and Scheme Draughtsmen required. Experienced Sheet Metal Work for Ventilating and Dust Recovery Plants, etc.—'PHONE: VISCO CRO. 4181. C 245

DESIGN ENGINEER AND DRAUGHTSMAN

DESIGN ENGINEER AND DRAUGHTSMAN required to join group in North London engaged in the design of special purpose machinery and fine mechanisms for mass production of light engineering products. The work is interesting, gives scope for initiative and has excellent prospects.

Applicants should have a minimum of H.N.C. Mechanical Engineering for Design vacancy and O.N.C. for draughtsman, and preferably some experience in mechanical design. Salary range for Design Engineer £850-£1200 and for Draughtsman £600-£850.

Apply, giving details of experience, qualifications, etc., to BOX C 239, Offices of ENGINEERING. (J7123)

DESIGN ASSISTANT

DESIGN ASSISTANT required by Marine Engineering Company, in Clyde area for work on Turbine and Oil Engine Machinery. Knowledge of Torsional Vibration problems, estimation of power requirements for ships, Propeller design and preparation of Heat Flow Charts, etc., desirable.

Applicants should be capable of working on own initiative with minimum supervision and preferably hold an Engineering degree or equivalent.

Superannuation Scheme available after qualifying period of satisfactory service. Please state fully experience, age and qualifications.—Write 2755, WM. PORTEUS & CO., GLASGOW. C 252

ENERGY

THE B-I-S-R-A has a vacancy for a UNIVERSITY GRADUATE IN PHYSICS OR ENGINEERING in the Energy Section of their Plant Engineering Division in London. The work will involve research into new applications and the efficient use of energy in all its forms in the steel industry, which is the largest consumer of fuel and power in Britain.

The publication of research papers is encouraged by the Association. Starting salary up to £1020 per annum according to age, qualifications and experience. Post is superannuated under the F.S.S.U.—Written applications only, quoting "E.N.3" to the PERSONNEL OFFICER, THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION, 11, PARK LANE, LONDON, W.1. C 250

RESIDENT ENGINEER

RESIDENT ENGINEER for reconstruction of the Swing Bridge at Caernarvon. Approximately 9/12 months appointment commencing July/August, 1960. Experience of welding essential. Salary £1000 per annum plus expenses allowance.—Applications giving full details of experience should be forwarded to the CONSULTING ENGINEERS, F. R. BULLEN & PARTNERS, DACRE HOUSE, DEAN FARRAR STREET, LONDON, S.W.1. C 244

ENGINEER

ENGINEER (about 30 years) required for Consulting Engineers' Office in Manchester. Engineering degree and/or corporate membership of a major engineering Institution; varied industrial experience an advantage. Technical investigations and reports in matters where litigation is being considered.—BOX C 236, Offices of ENGINEERING.

SENIOR DESIGN ENGINEER

Hydraulic Press Manufacturer requires SENIOR DESIGN ENGINEER to take charge of small expanding design office. Preferment given to man with broad experience in Press design, coupled with initiative and originality.—Write giving details of age, experience and salary required to BOX C 229, Offices of ENGINEERING.

QUALIFIED CIVIL ENGINEER

experienced in the Nuclear Energy field

required by Civil Engineering contracting company operating in a Commonwealth territory. Must have general knowledge of associated mechanical and electrical engineering problems and be able to take responsibility for programming and co-ordination of construction activities involving nuclear, mechanical, electrical and civil engineering.

With view early interview London, reply in complete confidence, giving particulars of experience and salary requirements to BOX Z.W.756, DEACON'S ADVERTISING, 36, LEADENHALL STREET, LONDON, E.C.3. C 222

GEAR DESIGN ENGINEER

Gear design engineer required with experience marine gearboxes or V.P. propellers. Vacancy is in busy and expanding Technical Department, where good salary will be paid for the right man, having H.N.C. or equivalent. Existing holiday arrangements respected. Superannuation scheme. Free life insurance.—Apply: TECHNICAL MANAGER, MODERN WHEEL DRIVE, LTD., LINDO LODGE, STANLEY AVENUE, CHESHAM, BUCKS. C 232

A. BOAKE, ROBERTS & CO. LTD.

REQUIRE

TWO EXPERIENCED DRAUGHTSMEN

for interesting and varied work relating to chemical plant. Minimum qualifications H.N.C. (mechanical) and age not under 25. Salary in accordance with age, qualifications and experience, but not less than £870 p.a.—Reply to THE PERSONNEL MANAGER, 100 CARPENTERS ROAD, LONDON, E.15. C 207

TECHNICAL ASSISTANT

TECHNICAL ASSISTANT REQUIRED for Brake Clutch Lining Manufacturers. Age 23 to 28. Preferably some experience of Technical Sales work, and O.N.C. in Mechanical Engineering as a minimum standard of technical education. Work involves Head Office duties and visits to customers throughout the country.—Apply in writing to: PERSONNEL OFFICER, BRAKE LININGS LTD., BUXTON, DERBYSHIRE. C 149

SENIOR DRAUGHTSMAN

SENIOR DRAUGHTSMAN, O.N.C. (MIN.), REQUIRED. Experience in one or more of the following essential: Cranes, excavators, truck mounted mobile cranes and contractors' plant. Good staff conditions. Pension scheme.—Applications in writing, giving all relevant particulars and approximate salary required to PERSONNEL MANAGER, RUSTON - BUCYRUS, LTD., EXCAVATOR WORKS, LINCOLN. C 150

AN ENGINEERING COMPANY

serving the Gas, Petroleum, Chemical and Steelmaking industries requires a

CHARTERED CIVIL ENGINEER

Candidates should be preferably 30/35 years of age with contracting and design office experience. Employment at first will be in the company's drawing office with opportunities later to take charge of projects operated from Head Office or from field project offices at home and overseas. Pension scheme. Assistance with housing.

Details of training, experience and salary required to BOX C 198, Offices of ENGINEERING.

THE GLACIER METAL CO. LTD.

invites applications from

YOUNG ENGINEERS

for posts in a

SPECIAL ASSIGNMENT GROUP

attached to the Chief Production Engineer at Company Headquarters

On entering, they will be deployed to work on special projects chosen to allow them to make an immediate impact on the work of the Company

Projects are of great interest and often concern new developments; they last some months each and may take place in any of the Company's factories in England or Scotland

After up to 18 months in the Group members are eligible for permanent positions in the Company where career prospects are excellent.

SALARY RANGE £950 to £1350 per annum. Requirements: a good degree, the completion of an apprenticeship and, to warrant appointment towards the upper part of the range, some practical experience. In particular, however, the Company is seeking for these positions men showing evidence of promotion potential.

Applications should be sent to:—
PERSONNEL DIVISIONAL MANAGER (Ref. S.A.)
GLACIER METAL CO. LTD.
EALING ROAD, ALPERTON
WEMBLEY, MIDDLESEX
C 219

WANTED FOR SOUTH AFRICA

PLANNERS, RATEFIXERS AND ESTIMATORS required by leading firm of Heavy Engineers in South Africa manufacturing for—

MINING INDUSTRY: Winders and Reduction Plant.
STEEL INDUSTRY: Rolling Mills and Auxiliary Equipments.
PETROLEUM AND CHEMICAL INDUSTRIES: Pressure Vessels and Heat Exchangers.
POWER SUPPLY INDUSTRY: Condensers and Circulating Pumps.

Applicants must have a minimum of five years' experience as Planners, Ratefixers or Estimators in the heavy engineering industry, and preference will be given to those who have specialised in the above-mentioned fields. Salary in accordance with ability, experience and qualifications. Liberal leave with additional long service benefits after six years. Medical benefit and Pension funds. Housing and assisted passage facilities available.

Apply in writing, giving full details of age, experience, qualifications and marital status and enclosing a recent photograph, to:—
THE LONDON REPRESENTATIVE
VANDERBIJL ENGINEERING CORPORATION, LTD.,
723-737, THE ADELPHI
JOHN ADAM STREET
LONDON, W.C.2 C 216

STRESS ENGINEER

DAVY AND UNITED ENGINEERING COMPANY LIMITED

the largest producers and designers of rolling mill equipment in Great Britain require a Graduate Mechanical Engineer with experience of stressing techniques to expand and develop an existing stress section.

He will be responsible to the Chief Engineer for the development of standard analytical approach to general design problems, this work will entail the theoretical analysis of dynamic machines and structures subject to impact and thermal loading. Complete research facilities exist for fundamental investigations into problems encountered, these facilities include a field research team equipped to carry out stress measurement on working components, research workshop together with a photo-elastic bench. Knowledge of heavy welded fabrication techniques would be an advantage but is not essential.

Comprehensive amenities, Superannuation Scheme. Existing holiday arrangements honoured.

Apply with full details of age, experience and qualifications to:—
PERSONNEL DEPARTMENT
DAVY & UNITED ENGINEERING COMPANY LIMITED
DARNALL WORKS
SHEFFIELD, 9 C 241

A PROMINENT COMPANY SITUATED IN THE MIDLANDS REQUIRES IMMEDIATELY

ENGINEERS

in the following grades

SENIOR DESIGNERS
SENIOR ENGINEERS

To assist in general mechanical and hydraulic engineering design and development associated with small auxiliary Power Supply Units.

The work is of a varied and interesting nature offering ample scope for original thought.

Applications for these positions are invited from candidates possessing appropriate experience, together with a degree or H.N.C. in Mechanical Engineering.

Status and salary will be determined by qualifications and experience and Company benefits include a generous Pension and Life Insurance Scheme.

Interviews will be arranged at the Company's establishment or at convenient centres throughout the country, and applications should be addressed to BOX C 221, Offices of ENGINEERING, quoting Reference ARM/MECH DEV/7. C 221

DESIGN AND DETAIL DRAUGHTSMAN

required, with experience of Electric Overhead Travelling Cranes and Handling Equipment as used in the iron and steel industry.

Life Assurance and Contributory Pension Scheme.

Applicants should write to the

CHIEF ENGINEER
APPLEBY-FRODINGHAM STEEL CO.,
SCUNTHORPE, LINCS,

stating age and qualifications, and giving full details of experience. C 212

JIG AND TOOL DRAUGHTSMEN

required

Previous experience in Machine Shop Tooling and design of Aircraft Assembly Jigs necessary, technical education to O.N.C. standard desirable.

Contributory Staff Pension and Life Assurance Scheme.

Applications, giving full details of qualifications, experience, age and salary required, and quoting ref. H.A.L./120/E, should be forwarded to:—

THE PERSONNEL MANAGER,
HUNTING AIRCRAFT LTD.,
LUTON AIRPORT,
BEDS. C 164

RHODESIAN SELECTION TRUST GROUP

ELECTRICAL AND MECHANICAL ENGINEERS

A large copper mine in the Rhodesian Selection Trust Group requires Senior Engineers. Applicants should hold a degree in Electrical or Mechanical Engineering and have had subsequent experience in heavy engineering work. They should preferably be under 35 years of age.

Duties will consist of planning engineering projects of a varied nature in connection with large scale mining operations including power generation and distribution, mine shafts and haulage, ore treatment, smelting and other associated heavy engineering plant.

Basic starting salary from £1750 p.a. depending on qualifications and experience. There is also a bonus scheme, at present paying 43½ per cent on basic pay and a variable cost-of-living allowance currently £83 p.a. The company has generous pension, life assurance and medical schemes and it also operates share purchase and house purchase arrangements.

Leave at 51 days p.a. may be accumulated over three years' service.

The outward passages for the employee and his family would be paid by the company.

Full particulars covering age, qualifications and experience, should be sent in confidence to:—

THE OVERSEAS PERSONNEL OFFICER
SELECTION TRUST LIMITED
MASON'S AVENUE
COLEMAN STREET
LONDON, E.C.2

Please quote R.9 Eg. C 247

ASSISTANT
CHIEF ENGINEER

ASSISTANT CHIEF ENGINEER required by large retail distributive organisation with Engineering department responsible for all projects of lighting, heating, ventilation and mechanical handling in departmental stores, offices and factories, maintenance of lifts, refrigeration plants and a large fleet of vehicles.

Applicants should have served a recognised engineering apprenticeship and be a corporate or graduate member of the Institution of Mechanical or Electrical Engineers or have equivalent qualifications. Permanent position with Superannuation scheme.

Apply stating age and giving full particulars of experience and qualifications with salary required to:—

THE STAFF MANAGER
ROYAL ARSENAL CO-OPERATIVE SOCIETY LIMITED
71 POWIS STREET
WOOLWICH, S.E.18 C 242

'Engineering' Appointments Section

ADVERTISEMENT RATES

CLASSIFICATIONS: Public Appointments, Appointments Open, Appointments Wanted.

TYPES OF ADVERTISEMENTS:

(a) "Appointments Illustrated" and illustrated careers advertisements: photographs or drawings may be used in conjunction with type matter.

Rates: per page (12 in. by 9 in.) £100
half page £54
quarter page £29

(b) Semi-display: type matter, with or without surrounding rule, name block or symbol.

Rates: per page (12 in. by 9 in.) £100
per half page £54
quarter page £29
per single column inch .. .. £2 14s.

(c) Single column "run-on" advertisements: approximately 6 words to the line, 12 lines to the inch.

Rate per line .. .. 4s. 6d.
(Minimum charge 18s.)

SERIES DISCOUNTS: 5 per cent. on 6 insertions; 10 per cent. on 13; 15 per cent. on 26.
BOX NUMBER: 2s.
COPY DATE: First post Monday.
BLOCKS: To be mounted ready for printing. Screen 100.
ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663).

Company Meetings

Quarter page, £29; half page, £54; full page, £100.

COPY DATE: First post Monday.

BLOCKS: To be mounted ready for printing. Screen 100.

ORDERS TO: "Engineering" 36, Bedford Street, London, W.C.2. (Telephone TEMple Bar 3663).

COMPANY MEETINGS

RANSOMES SIMS & JEFFERIES, LIMITED

Improved Results

The Seventy-sixth Annual General Meeting of Ransomes Sims & Jefferies, Limited, was held on May 27 at Ipswich.

SIR REUBEN HUNT, the chairman, presided. The following is an extract from the chairman's circulated comments on the report and accounts for the year ended December 31, 1959:— The trading balance of the Group for the year to December, 1959, amounted to £870,810 (1958 £624,477). A dividend was recommended for the year of 7½ per cent on the Ordinary share capital of £3,750,000 together with an allocation of £200,000 to General Reserve leaving £222,838 carried forward on Profit and Loss Account (1958, £237,090). The improved results have arisen from several causes. Volume of despatches increased, especially lawn mowers; the hot dry summer increased the demand for our tillage implements and parts; and there was a further concentration of production accompanied by a sustained effort on the part of all our employees.

Production of the new 902 self-propelled combine has been concentrated at Nacton alongside the production of agricultural implements, the older harvesting machinery factory having been used as an extension to Press Shop capacity and additional stores. This transfer of the manufacture of combines, particularly having regard to the number which had to be made, has been something of a major operation and it has been most successful.

Ransomes lawn mower sales for the year 1958 were reported as the highest ever attained, but for 1959 Ransomes have done even better and look forward to a further increase both in output and sales during 1960.

To increase further the manufacturing volume of Ransomes electric battery forklift and platform trucks an agreement has been reached with Hyster Company of Portland, Oregon, U.S.A., by which Hyster take over sole responsibility for the sale of these electric trucks throughout the world. It is anticipated that from this selling arrangement considerable advantage will accrue to both companies.

So far as the general outlook is concerned the difficulties of estimating some twelve months before the season really starts the exact quantities of each particular type of implement or farm machinery required are again stressed. The Board's policy is to over provide rather than under provide in the knowledge that an over provision should be absorbed by the following year's sales. Although it is difficult to guess accurately in our business, nevertheless Ransomes can see no reason why 1960 should not be a satisfactory trading year if costs do not rise more quickly than productivity and if sales are maintained.

The chairman, addressing the meeting, said: There is not much I can add to my comments that appear in the Annual Report but you will be interested to know that the results for the first four months of 1960 indicate that orders and dispatches are running at much the same rate as last year. Our costs have risen owing to the shortened working week. This will affect our ability to sell in export markets and the fall in the value of second hand machinery has reduced the sale of new equipment in the Home Market.

The report and accounts were adopted. C 199

GUEST, KEEN AND NETTLEFOLDS, LIMITED

Mr. K. S. Peacock's Review

The Sixtieth Annual General Meeting of Guest, Keen and Nettlefolds, Limited, will be held on June 23 at Birmingham.

The following are extracts from the circulated statement by the chairman and managing director, Mr. K. S. Peacock, for the 52 weeks ended January 2, 1960.

Group turnover with outside customers increased from £208,996,000 in 1958 to £220,807,000 in 1959. The increase of £12 million was achieved in spite of reductions in certain iron and steel prices in the United Kingdom and the highly competitive conditions existing in the early part of the year, particularly in the engineering companies in the United Kingdom.

In my Statement last year I warned Stockholders that it then seemed possible that the trading results of 1959 would not equal those of 1958 unless there was some marked improvement in general conditions. The final outcome for the year 1959 has been reasonably satisfactory.

The surplus on trading increased by £1,715,000 to £25,831,899, after charging £1,114,000 more for depreciation, and the total profit after taxation was up by £2,132,000 to £13,414,174.

DIVIDEND POLICY

Your Board recommend a final dividend for 1959 of 10 per cent, to give a total for the year of 15 per cent compared with 13 per cent for 1958. Your Board, however, are of the opinion that they must maintain the policy of large retentions of profit in order to finance the continuing expansion of the Group and in particular the massive schemes of capital expenditure on which our success so largely depends.

EXPANSION OF STEEL OUTPUT

In a steel works such schemes take a considerable length of time to bring to fruition and it is therefore necessary from time to time to investigate the probable long-term trend of demand for steel products. The British Iron & Steel Federation, in conjunction with the Iron & Steel Board, have been engaged in this exercise for as far ahead as 1965 in regard to the products coming under their responsibility. We have made a similar survey for our own steel works, whose ownership by the Group we consider vital. From this it is clear that, to take care of the likely future demands by our engineering companies on the Group steel works and to replace certain outside supplies, expansion of output at the steel works is required on a long-term basis. This matter has received a great deal of consideration and we feel it necessary to go forward with alterations and expansions at our three steel works at an approximate cost of £20,000,000. Although your Board have approved these proposals in principle, some variations may take place in these schemes from time to time. The expenditure will be spread over the next five years, but it is expected that the heaviest amounts will fall in the years 1960, 1961 and 1962. Out of the total cost of these schemes only £2,225,000 is included in the total figure of £18,600,000 expenditure outstanding at 2nd January, 1960.

PRESENT TRADING CONDITIONS

Activity—Profits—Prices

Present trading conditions are good and the outlook for the future is promising, with almost all sections of the Group heavily occupied with substantial order books. It must, however, be realised that it is only the high rate of activity in the engineering works that enables them to operate at a reasonable rate of profit, as the improvements in operating efficiency which have been secured in almost every one of our works by our large programmes of capital expenditure have been absorbed by continuous increases in national wage rates which in their turn inflate many other items of cost over which we have little or no control. We have made strenuous efforts to keep down prices of our finished products but some increases can no longer be avoided. C 224

Companies

A Mixed Year for Harland and Wolff

THE continued shipping depression, the decline in ship repairing activities and the smaller amount of voyage repairs and maintenance work have all combined to reduce the trading profit from last year's operations by HARLAND AND WOLFF.

Reflecting the past excellence of the order book, and not the present rate of ordering, the launching output at Belfast has been so good that it is now possible to begin work on the re-organisation and improvement of the bigger slipways. The capacity of the cranes and the welding facilities will be increased. There will be considerable improvement both in capacity and efficiency.

The launching programme in the past year was made up of 12 merchant vessels, a frigate and various smaller craft, a total of 163,115 tons.

This included the 45,000 ton Canberra, launched in March for P & O. She is the largest merchant ship launched from a United Kingdom yard since 1938.

Much of the Harland and Wolff yard's present activity is on naval contracts. Earlier this year a frigate was handed over to the Indian Navy and work continues for the same fleet on the light fleet carrier, Hercules. For the Royal Navy the frigate Berwick is being fitted out, the frigate Weymouth and the guided missile destroyer Kent are at a very early stage of building.

The steel constructional division's contribution to the company's activities is described by the chairman, Sir Frederick Rebbeck, as important. Output from the industrial engine and electrical divisions was satisfactory although some reduction in demand took place.

The marine engineering division was operating at a high level of activity throughout the year producing main propelling units amounting in all to 221,600 i.h.p.

and a Difficult Time for Cammell Laird

The reduced surplus for last year of CAMMELL LAIRD and its subsidiaries indicates the difficulties that have beset shipbuilders and capital equipment manufacturers due to the shipping position and the prolonged effects of the 1957-58 period of credit squeeze.

The surplus before tax declined from £1,486,704 in 1958 to £427,192.

Of conditions as the group finds them now, the chairman, Admiral Sir Michael M. Denny, reports that there have recently been a few more enquiries for ships and that conditions have improved in the steel industry.

Nine ships, totalling 86,523 tons, were launched and four ships, amounting to 51,518 tons, were completed. Work in progress includes a prototype guided missile destroyer, Devonshire.

The first phase of the shipyard reconstruction is expected to be completed this year, apart from the new dry dock which should be ready for use about the middle of 1961. While Sir Michael is no more optimistic about the future for shipbuilding and ship repair than Sir Frederick Rebbeck, he believes that the new facilities and production methods will make it possible for Cammell Laird to compete as keenly as any for what shipbuilding orders there are.

METROPOLITAN-CAMMELL CARRIAGE & WAGON made the first deliveries of 532 Piccadilly Tube cars for the LONDON TRANSPORT EXECUTIVE and will be producing these cars throughout this year. Wagons were exported to Pakistan, Rhodesia, Sudan, New Zealand, Nigeria and Angola, but with declining demand the wagon output was considerably down on previous years. Diesel railcars, standard coaches and sleeping cars for British Railways continued as an important part of the railway carriage workshops output and the first two of five Pullman de luxe express diesel trains ordered by British Railways were completed.

Cammell Laird hold 25 per cent of the ordinary share capital of the ENGLISH STEEL Corporation, which started the year with very poor demand but which enjoyed the general revival of activity in rolled products, drop forgings and springs—for motor vehicles and consumer durables generally—finishing the year with a better profit after tax than in 1958.

Heavy Machine Shops Still Below Capacity

The revival enjoyed by a number of sectors of ENGLISH STEEL did not extend to those producing components for the heavy engineering industries, apart from heavy steel castings.

Steel output fell from 505,000 to 464,200 tons. Much of this missing production would have been processed in other parts of the group, which means that the fall in steel tonnage is only a part of the overall loss of output.

The English Steel chairman, Viscount Knollys, says in his annual report that in these circumstances the trading profit—£4,300,861, which is £191,329 lower than in 1958—may be considered as satisfactory.

The early months of this year have not brought a significant change in the pattern. Until there is a revival in demand from the shipbuilding industry Viscount Knollys does not expect a full return to activity in the forges and heavy machine shops, which at present are not operating up to capacity.

In the steel foundries the heavy sections will be fully occupied during 1960 in producing large castings for steelworks extensions. There is also an increasing demand for specialised castings for railway vehicles. This does not mean that the lack of demand for railway wagons at home and abroad will not leave unused capacity at the railway spring plant at Sheffield and at TAYLOR BROTHERS, the Manchester wheel and axle plant.

Since a considerable proportion of the output of stainless steel is taken up in consumer durables the continuing boom in that section of the economy is expected to bring FIRTH-VICKERS STAINLESS STEELS another prosperous year. English Steel own half of Firth-Vickers Stainless and THOMAS FIRTH & JOHN BROWN the rest.

Much of the group's £2,657,000 capital expenditure of the year went on improving existing plant and meeting the needs of the Clean Air Act. Further spending due to the Act will go on for years.

The ordinary shares of English Steel are owned 25 per cent by CAMMELL LAIRD and 75 per cent by VICKERS Limited.

A Company Dedicated to the Forward View

Not many industrial groups, however large, have a separate company whose function is to act as a forward reconnaissance unit.

If any one industry in Britain is more likely than another to be so armed it is

electronics. And the group who have done exactly that are ELLIOTT-AUTOMATION Limited, to whose 50 companies and divisions is now added E-A AUTOMATION SYSTEMS Limited which, in the words of Mr. Leon Bagrit (inset), the Elliott chairman, is being set up because of the gulf growing between automatic control and " pure automation."

For the broadly based Elliott-Automation group the new company will in practice be a spearhead of advance in the application of automation, and the use of Elliott equipment. Mr. Bagrit summarised this neatly when he said that E-A Automation Systems will discover the need for new devices not yet produced.

Important steps in the application of automation are certainly on the way in the field of quality control. Its application here is more or less recent and a great deal of development is going on in instantaneous automatic analysis of material being processed.

Among the Elliott-Automation exhibits at the Instruments, Electronics and Automation exhibition at Olympia (23-28 May) was an Elliott " Optimat " which is shortly being delivered to an oil refinery as a control unit for a distillation column. This device uses computing techniques and exhibits a form of logic. It works by a continuous process of trial and error, adjusting variables in the distillation process.

" Pure automation " with the automatic feedback of information and correction during operation is not as widely in use as is often rather loosely assumed.

Heating the Desert Air

Patients and staff at the new Southwell Hospital, at Ahmadi on the coast of Kuwait, are protected from temperatures that reach 120° F and from intensely penetrating sand storms by an extremely comprehensive and effective air conditioning plant.

It has been installed, along with general services costing £600,000, by the BRIGHTSIDE HEATING AND ENGINEERING Company, of Ecclesfield, near Sheffield.

The air conditioner has ten main conditioning installations, all placed in five underground rooms. Once the air has had the sand eliminated and been through two stages of filtration the humidity is adjusted.

The turbomatic compressors, believed to be the first high speed centrifugal compressors of British manufacture in the world, were made by YORK SHIPLEY.

The Southwell hospital, financed by the KUWAIT OIL Company, whose architects for the job were HUCKLE AND DURKIN, of London and Liverpool, was opened by Sir Philip Southwell, former KOC chairman.

200 Years of Springs and Balances

The company that can claim two centuries of unbroken activity is rare. And the company that after so many years is still a family affair is rarer still.

Such a company is GEORGE SALTER, of West Bromwich, now celebrating its bi-centenary

It was in Bilston, Staffordshire, not far from the company's present works, that in 1760 Richard Salter set up his one-man business as a spring maker. His brother William made what were then called pocket steelyards, and it was Richard's springs which went into the pocket steelyards—they were, in fact, spring balances.

Growing fast, Richard Salter found it necessary to seek new premises, and he moved to a site " near the turnpike " at West Bromwich. His nephews John and George Salter joined him, and there the business has remained ever since.

When the move to West Bromwich was made, the original product, pocket steelyards, had been joined by others, all—except one—actuated by a spring, and springs and spring balances have remained the principal products of the firm ever since. The one exception to the spring products was bayonets, which the firm made in varying quantities—sometimes very large—for many years. This trade died out in the 19th century, but the spring and balance business has grown to proportions which Richard Salter could surely never have imagined. Salters can weigh anything from a ping-pong ball to a 200 ton casting, and now produce something like 5,000 different types of balance. How many types of spring they make it would be difficult to say, but there are certainly many thousands.

For well over a century the business was continued by the Salters, and their relatives the Bache family of Worcestershire, and when the last Salter died in 1917 it was the Baches who carried on the management. Today the firm is a private limited company, with members of the Bache family still in control.

There is not only a family tradition in the management, but also among the employees, a fact in which Salters take considerable pride. Four generations of one family in one department are common in Salter history, and long—sometimes very long—service by individuals is an outstanding feature. No one is likely to break the record of John Hughes, who joined Salters at the age of nine and worked for them until he was 91, but the tradition remains. People who join Salters tend to stay, a sign that the business is still a family one in every sense.

Bending Cold Plate for Pressure Vessels

A cold plate bending machine just installed is believed to be the largest machine of its type in the country. It combines in a three roll machine the advantages of both three and four roll bending machines.

The installation and commissioning of a 3-roll cold plate bending machine at the Erith engineering works of the General Electric Company Limited enables the company to bend mild steel plate up to 4¼ in thick and thus enables them to bend the thickest plate likely to be encountered in pressure vessel work. The bending machine has already been used to roll sections of the shells of winding engines and for work in connection with the Hunterston nuclear power station. It is believed to be the largest machine of its type in the country. It weighs 126 tons and has dimensions of 42 ft by 13¾ ft by 17½ ft high.

The rolls can be used for both bending and prebending. Prebending is the term used to describe the process of forming the ends of a plate, while bending refers to the actual rolling operation. Prebending is an essential requirement for rolling true cylinders—an operation which can be carried out on this machine.

Prebending of steel plates (32 tons per sq. in tensile) 13 ft 1½ in wide by 2⅝ in thick or 6 ft 6½ in wide by 3 in thick, can be carried out on the new rolls—the corresponding thicknesses for bending being 3⅛ in and 4¼ in. The minimum plate thickness which can be rolled is ⅜ in—the minimum diameter depending on plate thickness and width. Certain plate sizes can be bent to the diameter of the top roll, namely, 2 ft 7½ in. Bending speeds are 16·4 ft per min and 9·8 ft per min, depending on the plate dimensions.

The bottom rolls are adjustable vertically both individually and as a combined unit. This enables the new machine to roll the plates, and prebend them at both ends without having to turn the plates. It therefore incorporates the advantages of the normal 3-roll plate bending machine with those of the 4-roll machine.

The two main motors are of the wound rotor type, the prebending unit being rated at 107 h.p. (for vertical adjustment of the bottom rolls), and for the bending operation, 167 h.p.

The machine body comprises the two upright end frames, one incorporating a drop bearing and the other a tilting bearing, the adjusting drive mechanism, and the gearbox. The roll journal on the drop bearing side is protected by a closed bushing which remains on the roll when the drop bearing is swung down. Operation of the drop bearing is by a reversible hydraulic pump developing about 7 h.p.

The rolls are of high quality carbon steel and run in bronze bearings located in the two end frames. The bottom rolls which are 2 ft 6¼ in diameter, are fitted with articulated bearings which permit the inclination of the rolls for bending conical shells with a maximum angle at the apex of 20°. The top roll tilting device is a necessary feature of the cold plate bending machine since it enables the removal of closed shells. Inclining is effected by an oil cylinder supplied at both sides and sited at the driving end of the machine. The bearing in the frame at this end acts as a pivot for the tilting roll.

Strengthening of the drive permits the adjustment of the bottom rolls during bending. The adjusting gears for doing this are located in the end frames, and the three-phase driving motor is mounted at the frame end close to the gearbox, being connected to the bottom rolls at this end through reduction gearing. The drive is transmitted to the drop bearing end of each roll via a clutch and cardan shaft. The two hydraulic multi-disc jaw type clutches provide a safety device against overload, besides permitting the bottom rolls to be inclined for conical bending. The arrangement also allows both rolls to be operated as a single entity as indicated earlier. All high speed shafts run in roller bearings and the low speed shafts in large slide bearings.

The bending drive acting on the bottom rolls is located in a separate gear box, two hydraulically operated clutches permitting the choice of the speeds indicated earlier. The relevant three-phase 165 h.p. motor is positioned between the two end frames. To reduce as far as possible the idle running of the rolls when prebending and bending the plates, an electro-hydraulic actuated multi-disc brake is incorporated. This is additional to the reverse current braking system fitted to the drive motor, and described later.

The lubrication of the roll adjustment drive is effected through a centrally arranged oil circulation system. The reduction gearing lubrication is by oil bath or oil spraying. The main greasing points are supplied by a centrally placed high pressure greasing system, the power for which is taken from the bending drive. All other lubrication points are arranged in groups and supplied by manually operated grease pumps. A low pressure oil system is provided for the actuation of the multi-disc clutches in the adjustment drive and similarly for the jaw type clutches controlling the speed of the bending drives, and for the inclination of the bottom rolls.

The control of the rolls is effected from a raised platform, where all the indicating devices are grouped together in a control console. The console contains two meters for measuring the power taken by the rolls (in kilowatts) during bending and prebending, devices for indicating the relative position of the bottom rolls (particularly necessary for conical rolling), control switches and indicating lamps.

The electrical supply is brought in through a 2,400 A three-phase contactor with low voltage and overload releases. Some of the safety interlocks are arranged to trip out this contact should any abuse of the machine be attempted.

The main driving motor and that for the adjustment of the bottom rolls are of the wound rotor type with speed control by resistance in the rotor circuit. The former is controlled by a 5 position switch, each position being associated with an electronic time delay with a setting range from 0·1 to 5 sec. Each of the five relays operates a contactor to cut out a section of the resistance in the rotor circuit when a certain speed has been reached—the final contactor short circuiting the motor slip rings. Control of the adjusting motor speed is identical except that a 4-position switch is used. The rotor resistances are of the normal grid pattern.

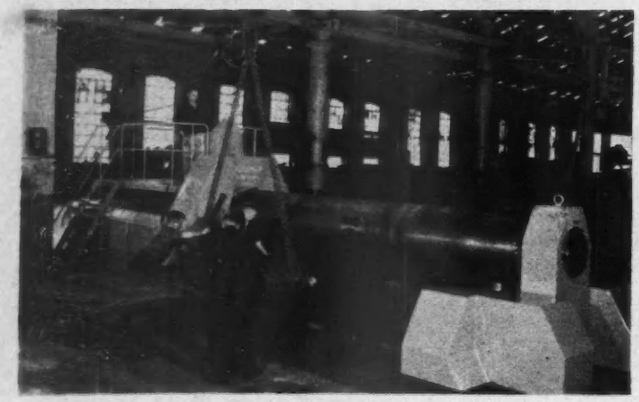
In addition to the normal electromagnetic brake, each motor is fitted with an a.c. injection system of reverse current braking, the operation of which is controlled by a brake monitor fitted on to the driving shaft of each motor.

Maintenance of the oil flow for the hydraulically operated equipment is essential and it is therefore interlocked with the operation of the motor drive. Satisfactory operation of the hydraulic system is indicated by a green light on the control console, which is arranged to flash should oil circulation fail: a klaxon also sounds under these conditions. A 7½ h.p. three-phase oil pump motor maintains the hydraulic pressure at 35 atmospheres.

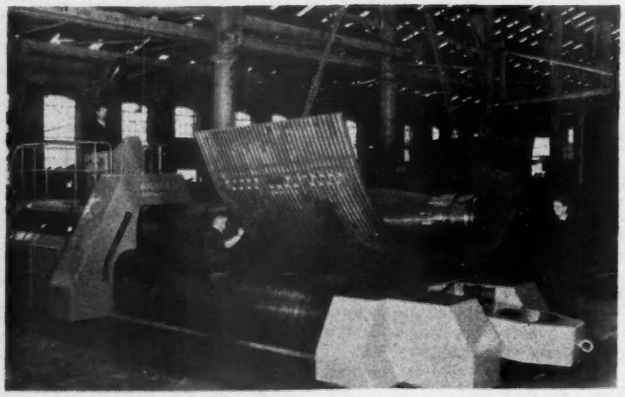
The relative position of the bottom rolls is indicated by magslips, a receiver being fitted at each end of each roll, and a corresponding transmitter on the control console. The rotor circuit of a transmitter and its appropriate receiver are connected in series and are supplied with a 240 V single phase voltage; the stator windings are also interconnected. Any movement of a bottom roll is translated into inches displacement from a given datum, and shown on a counter like dial on the control panel. By this means both rolls may be set horizontally or inclined to any angle up to 10° for conical rolling.

The 185 V d.c. supply for the many solenoid operated hydraulic valves is obtained from a selenium rectifier connected to the main incoming control panel.

The machine was supplied by Wagner and Company, of Dortmund, Germany, through their British agents, Vaughan Associates Limited, of Nottingham.



Inserting a 2 in thick mild steel plate into the bending machine for rolling to 16 ft diameter. The bottom rolls can be adjusted under load.



The removal of a rolled section requires the release of the nearside drop bearing and the tilting of the top roll as shown.

Automatic Recording of Production

At the recent Production Exhibition held at Olympia, the Special Projects Group of International Computers and Tabulators Limited showed a production and performance recording system for use in factory and plant control. The equipment can be attached to any number of production machines or processes and it provides, at some central point, performance details of the machines or processes. These details which are provided continuously and automatically include output (such as numbers of parts produced), total idle time per machine per shift, reasons for stoppages, times of stoppages, and the order numbers on which the machines are engaged. It is also possible to record other details such as shift number or operation number.

Data is recorded on both a line printer and on a card punch. The printer provides information for maintenance control, possibly as part of a fully integrated system incorporating communications (which can be built into the system). The punch provides standard punched cards which may be analysed off-line to provide accurate data and statistics for a production control system.

The equipment is particularly suitable for use in conjunction with computer production control systems.

Read-out from a particular production unit is automatically initiated when that machine ceases to produce at a pre-set rate. There is a facility for delaying read-out so that the system may ignore short permissable delays which might occur, for example, during tool changes. However, the duration of these delays is recorded on a totalising counter so that an accurate record of down time is available at the end of each shift. A full record of the state of a machine and the order on which it is engaged can be obtained on demand or automatically.

There are facilities for interrogating any machine from the control office to ascertain the progress of a particular order and to prepare a complete record of the state of all machines at the end of a shift.

Many other optional features are available, such as " plant state " lamp display panels and chart recorders. A wide range of transducers is available so that the output of any machine can be accurately recorded.

Extruding Brittle Materials

A promising new method of extruding brittle materials is being developed by the National Engineering Laboratory at East Kilbride. The billet is immersed in a fluid at high pressure, and the extrusion is carried out inside a high pressure container.

If a material like magnesium or bismuth is extruded in the ordinary way at room temperature with only a fairly small reduction of area, the surface of the product may be so badly cracked that the component is useless. Since materials behave in a more ductile fashion when surrounded by a fluid at high pressure, it seemed likely that better extrusions might be produced in this way.

Rods and tubes with an acceptable surface finish have been obtained with bismuth and magnesium at fluid pressures of a few tons per sq. in. The work so far has been carried out on a small scale, using billets of $\frac{3}{4}$ in diameter. Further work is in progress with 60 : 40 brass, but fluid pressures of more than 50 tons per sq. in are needed with this material to produce successful results.

It is hoped to develop the techniques to the stage where high pressure forming can be used as an industrial process for metals which cannot be worked by normal methods. One possible use might be in the manufacture of beryllium cans for nuclear reactors.

Certain aspects of pressurised extrusion are covered by British Patent Applications Nos. 17603/58 and 6626/59.

From Cars to Machine Tools

Last August, Renault Machine Tools (UK) Limited was formed as a wholly owned subsidiary of Renault, France, with the object in view of designing, building and marketing Renault machine tools incorporating the Renault electro-mechanical heads. Following a period of months living in a few offices, the company have acquired factory premises in the Shrewsbury area were several machines are now under construction.

The parent company have for many years designed and built machine tools not only for their own production in their many plants in France, but also for a wide variety of other industries. Throughout the United Kingdom, there are many Renault machines operating on many components ranging from railway rolling stock to washing machines.

Cold Extrusion of Titanium

Though cold extrusion is widely used in the forming of steel and other metals, the process has been applied little, if at all, in the production of titanium products. Titanium extrusion has probably been retarded most by the inability to achieve satisfactory surface finishes.

Technologists of the Battelle Memorial Institute have, however, in one phase of a recent research project, developed a surface treatment that produced excellent results in wire and tube drawing titanium and in reciprocating and rotary wear tests. The treatment consists of immersion of the metal in a fluoride-phosphate bath at room temperature. The resulting coating serves as a lubricant retainer (reduction of extrusion pressure and production of a good surface finish depend upon good lubrication).

During the study, many types of lubricants were evaluated and the solid film type produced the best surface finishes. Most effective of all were self-drying gum-resin mixtures containing 10 per cent graphite or 5 per cent graphite and 5 per cent molybdenum disulphide. With the combination of coating and lubricants, hollow shapes of titanium, with surface finishes of 30 to 60 microinches, were cold extruded at pressures comparable to those used for extruding similar steel shapes.

Standard for Metal-Arc Welding

The British Standards Institution have published part 2 of the standard for filler rods and wires for inert gas arc welding. This concerns " Wires for Gas-shielded Metal-arc Welding." It specifies requirements for 35 different types of ferrous and non-ferrous round wires for gas-shielded metal-arc welding normally supplied on reels.

The general section of the specification contains clauses on preferred diameters of, tolerances on, and the condition of, wire. There are also recommendations concerning reeling conditions, together with data on weight ranges for the wires in the various groups.

Requirements for the different types of wire (steel, copper and copper alloy, aluminium and aluminium alloy, nickel and nickel alloy) are grouped according to material in a separate section. Each set of requirements presents details of the applications and chemical compositions of the different wires. A full page table and related diagram provide a " quick reference " guide to preferred reel sizes.

The publication concludes with an appendix containing some notes on the welding of aluminium-magnesium and aluminium-magnesium-silicon alloys. Copies of the standard (BS 2901: 1960) may be obtained from the BSI, 2 Park Street, London, W1, and will cost you 7*s* 6*d*.

Automatic Temperature Control for Sintering

Following a trial period with an experimental installation, Associated Electrical Industries (Rugby) Limited are incorporating an advanced form of automatic temperature control on a number of electric resistance sintering furnaces at their Ardaloy factory at Rugby. Conversion of four furnaces to automatic working is now nearing completion and a total of eight such installations are expected to be in operation by the end of the year.

The technique adopted is based on the Electr-O-Volt proportional control system developed by Honeywell Controls Limited working in association with their ElectroniK controller instruments.

The main advantage derived is that the working temperature is now maintained within 2° C automatically as compared with 20° C using the previous manual control. The response to fluctuations is reported to be rapid and without overshoot. The control system also allows rapid changing from one working temperature to another.

New Machine Cheapens Laminated Sheet

A laminating machine, claimed to reduce the retail price of hard-surfaced decorative wall, ceiling and roof boards by one third to a half of the current prices, is now being manufactured by Mather and Platt Limited of Manchester under licence from C. A. Litzler Company, Incorporated, of Cleveland, Ohio.

The machine, which is known as the Centopress, applies polyester and vinyl films continuously without resorting to the use of static presses. Films preprinted with veneer or other effects can be applied to blockwood, plywood, chipboard, asbestos board, hardboard and fibreboard for indoor or outdoor use.

Sheet metal can be laminated with film equally well after cleansing and etching, and recent reports from the United States indicate that the machine can produce what is called " rigidised metal " by laminating thin aluminium, copper or stainless steel sheet to plywood. The output of the machine is in the region of 4,000 sq. ft per hour.

Machine Tools for China

William Asquith Limited of Shrewsbury, a member of the Asquith Machine Tool Corporation, are now completing erection of the fourth and fifth machines of an order for five Asquith Ram Type horizontal milling and boring machines placed by the China National Machinery Import Corporation. Four of the machines have a spindle diameter of 10 in and one machine has an 11 in spindle. This order was obtained against severe continental competition and followed negotiations which took place in Switzerland with a Chinese purchasing mission at the end of 1958.

The machines will be installed in various manufacturing plants in China, and, in addition to general heavy engineering work, they will be used for the production of rolling mills and turbines. The machines are the heaviest of their type produced anywhere in the world, weighing some 350 tons each and having a main driving motor developing 150 h.p.

The machines for China have been built jointly by the Halifax and Shrewsbury Works of the company.

When earlier machines of this type were on test, representatives of the China National Machinery Import Corporation visited Halifax and Shrewsbury and expressed themselves as highly satisfied with both finish and performance, being particularly impressed with their metal removing capacity, accuracy and rigidity when full power was being absorbed during the tests.

Engineering Service for the Collieries

Modernisation of engineering maintenance services was one of the tasks which the National Coal Board set itself. Carlton workshops, in south Yorkshire, exemplify the progress made.

WHEN the NCB took over the coal mines there were about 1,000 collieries in operation, some 600 of them being individually owned. No centralised engineering workshops existed nor, under the conditions at the time, was such centralisation practicable. On the maintenance side, therefore, the NCB was faced with the fact that the facilities needed modernisation and concentration into economic units. In addition, mechanisation and other changes in mining methods had brought about the need for much more extensive maintenance facilities than had hitherto existed. It was decided, therefore, that the servicing facilities should be organised to operate at two levels; first at the collieries, where preventive maintenance and first-aid repairs would be carried out, and second, by another planned system for reconditioning of all mining and ancillary machinery at regular intervals in central workshops serving all the pits in a given area. By this means there would be an improved use of labour, machine tools and equipment and a reduction in operating costs.

To implement their decision, the NCB set up a headquarters department located in London. This department, under a chief workshops engineer, drew up a general specification for both colliery and central workshops, and prepared a manual on *Workshops and Stores Design and Organisations* which was circulated to the Board's Divisions and Areas. This manual, incidentally, has since found a much wider readership, both at home and abroad, and is being used as a work of reference by students as well as others concerned with similar maintenance problems.

PRINCIPLES AND OBJECTIVES

NCB workshop practice is based on a number of principles which present day conditions have made of prime importance. Production losses from breakdowns of mechanical equipment would be much more serious than in the old days when hand tools were the main item of equipment. The cost of construction has risen, so that the best possible use must be made of the floor space provided; workshop equipment, too, is more costly, so very careful selection is necessary. In addition, skilled labour shortage makes it imperative to use to the best possible advantage all grades of worker. Finally, means must be provided to ensure that materials and spare parts are available at the place and time needed.

To meet these various requirements, the workshops are designed on a planned work flow basis, with forward progressive movement of the jobs throughout the shops and the minimum possible back tracking of both work and men. Job breakdown is also employed, with process planning procedures for all recurring reconditioning work. In the newly planned shops, the works manager has a clear picture of the work in progress. Dirt, inseparable from the operation of stripping machinery which has been in service, is confined to a small area, and by passing from one section to another, the manager can see that the movement of work is going according to plan. A planning office keeps a constant check on works loading, and is always in a position to state the potential works capacity at a specified time, so that maintenance can be planned ahead to suit requirements. In addition, a cost accountant is attached to the staff to provide, not only periodic returns as a routine matter, but also, at short notice, detailed cost figures relating to any specific item which may be under review.

RECEIPT AND DISPATCH

Besides providing engineering services of a more comprehensive nature than could be undertaken at colliery level, the central workshops can send out mobile gangs to supplement existing colliery resources where necessary; give a service for the recovery, repair, and re-issue of unserviceable parts; act as a centre at which defects can be investigated and modifications carried out, and also serve as a technical training unit for colliery operatives.

Twenty-one new or reconstructed central workshops have been incorporated into the standard pattern; eight more are being constructed or are in the planning stage, and a further eight of the older type are scheduled for reconstruction or replacement.

The central workshops of the Board's No. 4 (Carlton) Area, North Eastern Division, provide engineering services for collieries in the Barnsley-Pontefract area. They have been designed around four basic units: a holding centre, a reception and materials preparation centre, workshops and productive area, and administration and welfare block.

The first of the workshop units, the holding centre, is designed for storing both equipment awaiting overhaul and finished machinery which is ready for dispatch to the collieries. An overhead crane and a fork lift truck are provided for handling the equipment which, according to its size, is held on pallet racks, or stored on the floor. A portion of this building is used as a light stores, for goods which do not require crane handling, and is a central storage point for area stocks not directly related to the workshop services.

Near to the holding area is the workshop block, a single large working floor without dividing walls. Here the workshop sections are laid out according to work flow, with those sections of general service, such as the machine shop and toolroom, placed as centrally as possible. Overhead cranes of suitable capacity are provided in each bay of the workshop block. A cross service road separates the productive area from the administration block, and a second service road forms the division between the workshops and reception area.

All mechanical and electrical equipment coming into the shops for overhaul or repair, except locomotives and rail wagons, goes to the reception and inspection section, where it is stripped down, steam cleaned, degreased and inspected. At this point an inspection report is made out, showing which parts are in need of replacement. This report passes to the workshop stores adjacent to the reception area, so that new parts can be issued. Those parts suitable for further service are held on job trolleys or pallets, while parts needing repair are passed to the section concerned.

Machinery for overhaul arrives in a reception section, where it is stripped, inspected and note made of repairs required.

A blacksmiths' shop and heat treatment section are among the productive facilities provided in the NCB's Carlton Area central workshop.

Various specialised services are necessary for the repair of certain parts of colliery machinery, and separate sections are provided for this purpose. Electrical equipment parts are dealt with in a special section, and so are trailing electric cables. This job involves very little in the way of stripping and reassembling, and the work bypasses job reception, being accepted, examined for faults, repaired, tested and despatched by the section concerned.

Chain repair and annealing is another operation which is carried out independently of the main workshops, as the work does not require the assistance of any other section. Ropes and chains are dealt with in a separate workshop with road access from outside, thus reducing the need for internal transport.

GENERAL REPAIRS

Locomotive and boiler repair work is administratively part of the productive area, but the actual workshop is sited close to the materials preparation section. This is a matter of convenience, as it is thus possible to save the extra track laying and waste of space which would occur if the locomotive shop were in the productive area.

The machine shop, which serves several of the other productive sections, is specifically designed

Central Vacuum Cleaning Plant for Television Centre

The main studio and offices block under construction at Shepherds Bush, London, for the British Broadcasting Corporation, occupying some 3½ acres of ground, will be the largest building of its kind in Europe. It is planned so that ultimately it can be fully equipped for colour television. This unique and imposing building will have a centralised vacuum cleaning plant designed and installed by the Sturtevant Engineering Company Limited, of Cannon Street, London, EC. A description of the building was given in ENGINEERING for 21 March, 1958 (page 362).

The plant consists, for the most part, of a graduated piping system, in steel, ranging in size from 2 in to 4 in bore. The main runs are arranged horizontally in the false ceiling of the basement and are connected to a series of drop pipes and vertical mains throughout the building, these serving hose connections at the various floor levels. Architectural features such as false ceilings, ducts and casings are utilised for concealing the pipework where possible, and in most cases the only evidence of vacuum cleaning is an inconspicuous hose connection fitted flush in the wall at skirting level.

Some 350 hose connections are arranged at points throughout the building to provide cleaning facilities. Each hose connection is fitted with a self sealing hinged lid, and the insertion of a length of flexible suction hose gives immediate cleaning facilities to the operator.

The suction required for operating this extensive system is provided by two Sturtevant high efficiency type multistage turbo-exhausters, each driven by an electric motor developing 25 h.p. and designed to handle a large volume of air at high suction.

The exhausters are housed in the basement and convey through the piping system dust and litter collected during cleaning operations. The dust is deposited into portable containers for easy disposal.

Under normal working conditions each machine is connected to approximately half of the piping system; but to give economy of operation at non-peak cleaning times either exhauster can be connected to the whole of the piping system for which purpose the machines are inter-connected and a number of changeover valves provided.

The total capacity of the plant is sufficient to enable eight operators to work simultaneously on all the forms of cleaning required in this building, such as sweeping smooth floors and carpets, brushing down walls, ledges, without in any way disturbing dust into the atmosphere.

Power and Light for the Nation

Today, the Central Electricity Generating Board's grid is the largest system under unified control in the world. It consists of 238 power stations with an aggregate output capacity of 25,100 MW (over 33 million h.p.) and 433 main distributing centres or grid switching stations. Over 6,000 miles of high voltage transmission lines—the grid and supergrid—connect the system, which is operated as a unit, so that the most economic use is made of all the power stations.

How the grid is organised and operated, and what developments are taking place, are described in a brochure entitled *Pattern of Power* produced by the Central Electricity Generating Board, Winsley Street, London, W1.

The grid has had most important effects and has fully justified its existence, but that is far from being the end of the matter. Demand for electricity is rising at a rate which is roughly, on an international basis, doubling the units generated per head of population every 10 years.

In preparing a plan for the next stage in distribution, a supergrid, electrical requirements and coal resources in the eight zones into which the country is divided were examined. It was found that where coal could be transported by sea from pits near to the shipping port direct to power stations near to areas of demand, it would be cheaper to ship the coal and generate the current on the spot. On the other hand, if coal had to be moved by rail over distances varying from 40 to 120 miles, it would be more economical to generate the power near to the coal supply source and "export" the current to the major point of consumption.

To meet future needs most economically, electricity would have to be transmitted from the Midland area to the southern and north-western parts of the country. The supergrid, as planned, forms a ring of 275 kV lines round the Midlands, Lancashire and the West Riding of Yorkshire, with a connection northwards along the north-east coast and through Carlisle to Scotland. Further lines extend to the south and to the south-west.

By the end of 1959 about 1,120 route miles of the supergrid were in operation. The cost of the supergrid is £78 million, but it will provide a "pooling of power" system to meet energy requirements up to 1960. Without it, stand-by or extra generating plant would have been needed, and as this would have cost at least £150 million, there is a saving of £72 million.

Nor is the improvement of internal distribution of power the only development in hand. Across the English Channel, there is a highly developed French distribution system. An examination of load curves of the two countries showed that at times of peak power demand in Britain, France had power to spare, and vice-versa. Moreover, electricity in France is largely derived from hydro-electric sources, and at certain times there is water to spare. In return, this country could export power to France when water is short in the latter country.

A project has just been begun for laying two cables between Dungeness and Le Portel, near Boulogne, and each country will receive when needed 160 MW from the other.

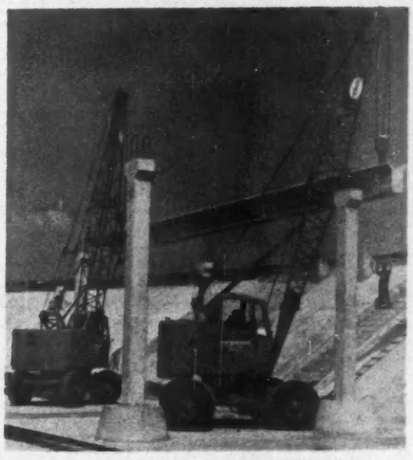
Cranes through a Culvert

A concrete lined reservoir being constructed at Weeton, Lancashire, for the Fylde Water Board, is 460 ft diameter, and will hold 16 million gallons of water. It will have an aluminium sheet roof, and to carry the sheeting, concrete stanchions and cross members are now being erected.

Two 6 ton diesel electric cranes made by Herbert Morris Limited, Loughborough, are being used to lift the stanchions and beams; this is a straightforward procedure, as shown by the accompanying illustration.

There is, however, only one means of access to the reservoir, a culvert passing through the side, and the cranes had to enter through this culvert, which was too small to enable them to pass in assembled condition. The culvert is 8 ft wide and 75 ft long, with a semi-circular roof of 4 ft radius, the arch being sprung from a height of 3 ft 6 in above floor level. This gives a maximum available height of 7 ft 6 in at the centre of the span. There is a rising gradient of 1 in 30 for the first 60 ft of the culvert, and the last 15 ft rises at 1 in 10.

To pass the cranes through the culvert they had to be dismantled to the extent of removing the road wheels, superstructure and jibs. Further dismantling was necessary to get the superstructures themselves into the reservoir. The jibs are 35 ft long, built up in sections which can easily be taken apart, and presented no difficulty. When the crane sections had been passed through the culvert they were reassembled, and the work of erecting the reservoir roof was started. When the roof is finished, the cranes will be removed in the same way.



To get these mobile cranes into the reservoir, they had to be partly dismantled and taken through a culvert.

Concluding **Engineering Service for the Collieries**

and equipped to provide an overhaul service, it being the policy of the NCB to recondition worn parts and not to produce new ones. This applies also to the plating and welding shops, which are mainly concerned with repairs to such items as pit cages, washery and screening plant, chutes and conveyor structures. Similar conditions apply in the blacksmiths' shop, which is mainly engaged on the sharpening of picks for coal cutters and the forging of brackets and other small parts for use in the plating and welding sections. Downdraught hearths are used to eliminate dust and dirt and to improve working conditions generally.

Reconditioned and replacement parts meet the serviceable components of a machine in the reassembly section, which is equipped with unit benches, job stands and parts trolleys or pallets to simplify handling and to give flexibility. This section is designed to handle a very wide range of machinery; coal cutters, for example, may occupy a floor space of 3 ft by 2 ft 6 in, while a haulage unit may need 30 ft by 10 ft.

On leaving the reassembly area, the mechanical assemblies are fitted with their electrical parts where necessary, and pass to the paint shop, and so to the holding area dispatch.

On the Shelf

By Frank H. Smith

HAS everybody gone exhibition mad? I have suddenly been overcome by the way cards drop out of journals, admitting one (or two) to some exhibition or other at one of the big halls. It is a good thing, I suppose, to be able to go along and have the things demonstrated and is, perhaps, better than having all those reps I spoke about the other week calling on one, but there is that danger of going to the things because they happen to be there and buying things whether you need them or not. Imagine getting back to the office and finding that in a rash moment you have bought a few miles of pipeline or a dozen crates of compressed air.

An "unpublished" item from the Board of Trade is "Index of Industries and Products" (with the Government Departments principally concerned). It seems that the object is to help anybody concerned with a particular product to track down the department most likely to be helpful. Suppose, for instance, you are crazy about moth killers and repellents, then you get in touch with Trade, but if your fancy runs to naphthalene balls, *they* are the pigeon of the Ministry of Power, Gas Division. Code letters alongside the department narrow the quarry down even more. The cost is 2*s* including postage, but I'm damned if I know what part of the Board you apply to. Try Horse Guards Avenue, SW1.

A long time ago I mentioned the first of the Library Association North Western Group's "Occasional Papers." My difficulty then was to tell you where to apply but I think I am right in saying that headquarters (Chaucer House, Malet Place, London, WC) will sell you a copy of No. 2 at 4*s* (and I had to look at the back cover to find that). It is a biographical note on John Benjamin Dancer, instrument maker, optician and the originator of microphotography. The author is L. L. Ardern.

Dr. Jay Goldman, chairman of the American Institute of Industrial Engineers, Inc., Research Information Committee, Department of Industrial Engineering, Washington University, St. Louis 5, Missouri, asks me to tell you that once a year the committee requests that research sources submit research performed in the area of industrial engineering. They then abstract it and publish it. I've done my bit, now it's up to you.

Library holdings fans might care to ask the British Transport Commission, British Railways Research Dept. Library, London Road, Derby, for their list of "Stocks of Periodicals held in the Libraries at London Road, Derby, and 222 Marylebone Road, London, NW1." There are one or two surprise items but if you were looking for them I do not suppose you would think of looking there. So perhaps it's not a good idea?

There's a firm at Brighton (104 Islingword Road) called Autobooks who produce manuals called *Autoserv*, *Autoserv Book II* and *Diesel Engine Service Manual*. The first two are 9 guineas a touch and the third is 10. They give "complete and comprehensive step by step overhaul procedure, data and specifications of British and Continental cars." Garage stuff?

A neat little catalogue comes from Birkhäuser Verlag, Basel, and they, it seems, produce books on Naturwissenschafter, Mathematik, Ingenieurwissenschaften Wissenschaft and Kultur. They seem the sort of mailing list on which it might be worthwhile being.

The Chelsea Publishing Company, of 50 East Fordham Road, New York 68, appear to be a bit concerned that their *The Theory of Matrices*, by Gantmacher, is the same as *Applications of the Theory of Matrices*, by Gantmakher, but published by Interscience. Both are derived from the same Russian source (Teoriya Matrits) and I suppose this confusion is all due to some devilish Communist plot.

The Gas Dynamics of Thrust

Jet Propulsion Engines. Edited by O. E. LANCASTER. High Speed Aerodynamics and Jet Propulsion, Volume 12. *Oxford University Press.* (140*s*)

Advanced Aero Engine Testing. Papers Presented at the Joint Meeting of the AGARD Combustion and Propulsion and Wind Tunnel and Model Testing Panels, Copenhagen, October, 1958. Edited by A. W. MORLEY and JEAN FABRI. AGARDograph No. 37. *Pergamon Press.* (63*s*)

Explosions, Detonations, Flammability and Ignition. By B. P. MULLINS and S. S. PENNER. *Pergamon Press.* (70*s*).

These three books are all very much for the specialist, and apart from the first, will be found to be of very little use to the elementary student of the subjects concerned.

The first is Volume 12 of the series published jointly by Oxford and Princeton University Press which covers the whole science of high-speed aerodynamics and jet propulsion. This volume, the last of the series, is concerned with jet propulsion engines *in toto*, as distinct from the fundamental science of the various components of engines which have been the topics of earlier volumes in the series.

The volume begins with a very useful definition of the forms of engine under discussion, distinguishing clearly between the rocket and the so-called fluid-flow engine. I commend this section to those popular writers who assume that all gas turbines are jet engines. The book moves on to a very interesting and readable survey of rockets and jet engines, ranging from antiquity (flight testing of a rocket to test a theoretician's whim is reported from the 4th century B.C.) to the date of publication, effectively 1950.

Following this introductory qualitative chapter, the book plunges rapidly into a fundamental treatise on the basic principles of jet propulsion. The definitions of power, work and efficiency are very rigorously presented, in fact, to such an extent that there appears to be an undue complication of the nomenclature. However, as this will undoubtedly be a standard reference on this subject, the rigour and complication are presumably inevitable, but an appendix or an introductory section to the book in which the symbols used throughout were assembled and defined, would be of great assistance in studying the text.

The remaining chapters of the volume deal in detail with the various forms of jet propulsion, using the term in its widest sense. The first chapter in this section is concerned with the turbojet engine, and ranges from a consideration of the thermodynamics of the simple cycle, through a discussion of component and complete engine analysis, to a study of such detailed topics as the effect of humidity on performance and different types of thrust augmentors. In this chapter there are some excellent examples of the aerodynamicist's penchant for drawing optimistic lines through widely scattered points. The turboprop engine follows on logically from the work on the turbojet, and there is a useful introduction to the question of propeller design. This section might appear to be out of place in a text of the kind under review, but this is indeed not the case. A chapter on the ramjet follows, which includes a very comprehensive account of the facilities required for testing this type of power unit.

The text goes on to deal with what might be termed unconventional types of power plant, beginning with a chapter on wave engines. This term includes the intermittent jet unit (familiar to the layman in the V1, or "doodle-bug"), but is applied specifically to compressorless engines which involve a pressure exchange process. A very full theoretical treatment of such devices is given.

A section on rockets follows, and almost a quarter of the volume is devoted to this fashionable form of jet propulsion. The liquid-fuel and the solid-propellent engine are dealt with separately and in a most complete manner, which ranges from discussion of the desirable properties of propellents to such detailed considerations as the heat-transfer performance of cooling methods for combustion chambers and nozzles.

Rockets lend themselves to combinations with the more conventional turbojets, and a chapter on these combined power units follows which savours very much of science fiction with such terms as "ram-rocket" and "air turbo-rocket." However, a section on the jet rotor brings the reader back to the present, even though the most likely application of this form of power plant is to future VTOL (vertical take-off) aircraft.

A penultimate chapter is concerned with nuclear energy, and this seems almost fatuous in a book of this nature. There is the space only to deal with this topic in the most general way, and the chapter has little particular application to the main subject of the book, jet propulsion engines.

A final chapter is concerned with the future prospects of jet propulsion. One might have hoped for a rather more specific survey of the prospects than the philosophical discourse which makes up the greater part of this chapter. Of the 25,344 types of power plant available to us in the future, according to the reasoning presented, the most fascinating is the Terrajet, the account of which does more to illuminate in your reviewer's mind dim memories of boyhood reading than the future of jet propulsion.

The second of the books under review contains the papers and the discussion thereon, presented at a symposium held under the auspices of AGARD in Copenhagen in October, 1958. Part 1 of the book contains four papers under the general title of "engine test facilities." The first of these is a broad review of some propulsion system problems investigated in the test facility of the National Advisory Committee for Aeronautics. The author touches briefly upon the correlation of engine test results, altitude effects, inlet flow distortion, transient operation and concludes with a description of the relative utilitics of subsonic and supersonic wind tunnels for turboprop and ramjet investigations. The second paper deals in more detail with the investigation of inlet flow distortion and its effects on performance and transient testing, already discussed, and goes on to some particular problems of high-altitude simulation, including the performance of diffusers for such work. The remaining two papers revert to more general topics, and make available a fairly complete description of the engine test facilities available in the United States and France. To the lay reader the cost of testing on the scale described must loom very large, for power requirements of 100 MW seem commonplace in this type of work. Presumably the taxpayers of the countries concerned with such work must accept its necessity, and the inevitability of having to pay for it.

Part 2 of the book contains five papers on engine component testing. The first of these is an English paper on the use of models in turbine and compressor research. It indicates that while models may yield data relevant to the design of full-scale turbines, the same is not true of compressors. The eternal problem of combustion chamber scaling, that is the application of the theory of models to these components, is discussed in the next paper. The complexity of the problem, which is made apparent in the third of the books under review, is also clear from this paper, which seems to suggest that if one only takes enough dimensionless groups and raises them to powers covering a sufficient range of values, one can correlate anything, even combustion problems. The book concludes with a separate general paper on supersonic flight testing, but prior to this there are two papers on the application of non-dimensional parameters to the prediction of engine performance, and on the applicability of component test data to complete engines. These do much to answer any of

the taxpayers referred to above who may ask whether testing on the scale described in the first part of the book is really necessary. Indeed it is!

The third book considers the combustion problem in general, and is divided into two parts both of which are, to quote from the introduction, " addressed to the reader with some familiarity of at least those parts of combustion research which may be considered to make up ' classical ' material." The first part of the book is concerned with analytical studies of selected combustion problems and requires a high mathematical standard of the reader who is to benefit from this text. The studies include the fundamentals of aerothermochemistry, explosion limits and reactions in closed vessels, detonation waves in gases, flammability limits and ignition and heterogeneous combustion. It is significant that in this last section, which is closest to the interests of the combustion engineer, it is stated that " the absolute prediction of the rates of spray burning . . . is not possible in practice." This suggests that combustion theory and engineering practice are still well separated.

In part 2 of the book the aim is " to review critically and correlate experimental data on flammability and to examine basic principles . . ." This aim is achieved, with the presentation of a large amount of factual empirical data relating to the problems discussed, and an exhaustive bibliography. This work suggests that the gap between practical combustion problems and laboratory-type experimental studies is as large as that referred to in connection with the first part of the book, for the reader finds such phrases as, " the applicability of kinetic combustion data to engine combustion is indeed a difficult and often contentious subject," and " perfect simulation of combustion conditions in a turbojet or ramjet is scarcely possible."

Again to quote the introduction, " much additional analytical work, supported by fundamental experimental combustion research has yet to be done before a useful (*sic*) theory of flammability and ignition processes is achieved."

This is a complete statement of the present position of combustion research as evidenced by this book.

F. J. Bayley

Feminine Status Goes to the Wall

The Four Window Girl, or How to Make More Money Than Men. By Shepherd Mead. *T. V. Boardman.* (12*s* 6*d*)

Mrs. Frayle (Marie to everyone on very short acquaintance), goes back to work to keep herself and her son, on the advice of her bank manager. On the death of her husband their hire purchases have caught up with her. The snowball created by selling something being purchased over a period in order to put down the initial payment on something else, surely could not happen here.

Mateyness seems to be the atmosphere of the business into which she is introduced as a shorthand typist, and her advance from a member of the typing pool—where her next door neighbour seems to spend her time creating soup on an electric ring—upwards from boss to boss is astonishing. In any country one has to cope with the vagaries of one's boss and his hobbies, and often with his wife as well, but the story of Mrs. Frayle's upward progress left one rather breathless. Nor do all her methods appear to be very honest.

There is a belief in England that the size of an official's desk indicates his standing—in America it would appear that it is the number of windows in his office. Mrs. Frayle starts without a window, working for more than one man, none of whom has more than a cubbyhole and not a window between them. By various means she progresses upwards, floor by floor, until she is working for a man with first one window and then two. She herself first works in the outer sanctum without a window, but in time gets an office next door with one window, immediately to become a personal assistant and no longer a secretary. Her rise from a weekly wage to a yearly one is also rapid and staggering.

Finally she marries the boss and sets up in business on her own, becoming the occupier of an office with four windows.

One's sympathy went out to her secretary, her asides to whom are in italics throughout the book. It is amusingly illustrated and light and easy to read.

The book is an astonishing history of the rapid advance from shorthand typist to boss, and a great deal could not happen here—one wonders whether it could really happen in America. If you like and understand American humour (or should it be " humor "?) then you will enjoy this book.

Evelyn Hamilton

Something to Say is Half Way to Writing Well

The Scientific Background. A. Norman Jeffares and M. Bryn Davies. *Pitman.* (21*s*)

Recently appointed to the chair of English at Leeds University, Professor Jeffares has marked the occasion by publishing this badly needed book in collaboration with a former colleague in the University of Adelaide. It deals with two subjects vital to science and education: first, the use of English as an essential instrument for science and technology; second, the balance between science and the humanities in education today. The authors treat these subjects in a vigorous 21-page introduction and by means of an anthology recommended to all who have not forgotten the pleasures of reading for its own sake.

As the Royal Society prepares for its third centenary, the authors rightly remind us that the founders of the Society were men of wide culture and that the English language was one of their major problems. The Society, three hundred years ago, found it necessary to " exact from all its members a close, naked, natural way of speaking; positive expressions; clear senses; a native easiness, bringing all things as near to mathematical plainness as they can." The effect of this policy on the ornate Latinisms of the 17th century is illustrated by the revised version (1676) of a report of a scientific experiment that was first written up some fifteen years earlier.

We seem to be due for another linguistic spring-cleaning. This book provides evidence enough of clutter and clumsy style in scientific papers, and of specialist jargon incomprehensible outside the specialist circle. The authors assume, with apparent justice, that the average student of science needs to be taught to write. They admit that even a professor of English can make grammatical errors—though their own part of the book is admirably written. It would be interesting to test the effects of their teaching on scientific papers fifteen years hence.

Professor Jeffares recommends one method both for improving scientific English and for removing the ignorance of the arts student and the scientist of each other's worlds. His proposal is not to make scientists read English literature " as it is commonly conceived by teachers of English," nor to introduce ordinary scientific textbooks into the English curriculum. It is " to engage the interest of the future scientist in good English " through the writings of scientists who can write well, and to use the same medium to give the future arts student an insight into science.

Hence this anthology. But action lies with teachers of English, who must include classic scientists in their syllabus, and with teachers of science, who with similar material must train their students " to evaluate language critically and use it precisely."

The hundred extracts chosen as examples of good scientific and practical English make this proposal convincing. They show how superbly scientists *can* write. In fact, the reader begins to wonder whether some of the best and soundest of modern English literature has not been produced by scientists and men of action. The selection is partly traditional (Harvey, Newton, Bentham, Darwin, Faraday), partly very original (extracts from *Field Service Regulations*, and " How to Climb the Turret of King's College Chapel "). It includes purple passages, and plain reports by men who competently say what they mean. The standard of style and of effectiveness of communication is kept universally high, without being above the level of easy readability.

The authors set questions " simply to suggest means by which the passages can be used for the furtherance of clear and lucid expression." The chief question that remains in my mind is how in practice teachers *will* use material for that purpose. But the theory and the samples provided are excellent.

R. A. Close

Fragile! Handle with Forethought

Package Design Engineering. By K. Brown. *John Wiley, New York; Chapman and Hall, London.* (68*s*)

Hailing from the United States, this book contains something of interest and value for certain sections of the packaging industry in this country. But it offers certain problems to the reviewer, and those expecting to find within its covers a handy superficial survey of the whole vast field described by the word " packaging " should take another look at the title. The author has left severely alone the field of retail, over-the-counter packages, with their sales appeal attributes, and has concentrated on the structural design of transit packages in wood, fibreboard and metal, in the range called for by such items as, for instance, cathode ray tubes, typewriters, and trifles like internal combustion engines and guided missiles.

A compact volume, the book does not at first glance look like something costing 68*s* and possibly this price arises from the publishers' feeling that the market would justify only a small and uneconomical printing run. But while the majority of those in this country who consider themselves knowledgeable about " packaging " will probably find themselves out of their depth and struggling in a sea of calculations, much

Continued on next page

information can be found within these pages concerning that part of the packaging field which the author has chosen. Much of the substance of the book springs obviously from his experience with aircraft and with armed-service requirements.

He opens with a survey of the principles of statics, dynamics, and mathematics which apply to the structural design problem, and the reader is shown how to handle moments, resultants, couples, and so on. It seems unlikely that the uninitiated can benefit greatly from this survey but it will serve as a useful reminder for those whose knowledge of engineering has not been kept polished by constant use; and problems are set to assist such readers towards facility in handling these matters. It is fair to say that the design of packages of this nature ought only to be undertaken by those well trained in structural engineering, and since such people are ordinarily familiar with the principles involved, there was perhaps no need to devote one-third of the book to their recapitulation. However, the author proceeds to study the application of these principles to the calculation of stresses due to static loads, transit shocks, and other hazards, giving numerous diagrams and examples and setting out methods of padding, cushioning, and suspension to take care of the stresses which arise. Useful guidance is given regarding the characteristics of vibration shocks likely to be met in trains, aircraft, ships and road transport. The use of accelerometers for such purposes as practical measurement of shocks, discovery of resonant frequencies, and assessing the amount of cushioning required is also treated.

In view of the writer's background, it is natural that standard test procedures quoted are in the main from United States sources. This will not necessarily invalidate them as a guide to British students but care should be taken where officially recognised standards may vary in this country from those used in America.

No mention is made of refrigerated packaging, though problems concerning the moisture vapour content of air enclosed in transit packages are dealt with and a psychometric chart from the General Electric Company of America illustrates short cuts to the solution of problems in this field.

Within its limits the book contains a great deal of information. A future edition might benefit from an expanded index, a bibliography on this or related subjects, and some tidying up of the references in the text to diagrams. Criticism of this kind, however, should be conditioned by the author's statement that the book is intended as a guide and to represent a method of approach rather than as a discussion of the many intricate problems represented by each container design project of the kind with which he is dealing.

N. F. PHILLIPS

New Books

The Newcomen Society Transactions. Volume 30, 1955-56 and 1956-57. *W. Heffer and Sons, Cambridge.* (50*s*)

This latest volume in a valuable series includes papers on the prehistory of the steamboat, the origins of the Cornish man-engine, the differential gear, and a short technical biography of F. W. Lanchester.

Physics of the Atom. By M. RUSSELL WEHR and JAMES A. RICHARDS. *Addison-Wesley Publishing Co., Reading, Mass., and London.* (49*s*)

Following, for the most part, the actual sequence of discoveries in modern physics, this textbook is written in an informal style and is intended to follow on from university general physics courses.

Dictionary of Terms Used in the Theory and Practice of Mechanical Engineering. Originally compiled by J. G. HORNER. 8th edition revised by Staton Abbey. *Technical Press.* (27*s* 6*d*)

Mr. Horner's original work now forms the second part of this reference work, and is devoted to general and traditional terms, while the first part covers modern terms. The form of definition makes this something of a condensed encyclopaedia.

Metallizing Handbook. By H. S. INGHAM and A. P. SHEPARD. 7th edition. *Metallizing Equipment Co., Ltd., Chobham, Woking.* (35*s* 10*d*)

Metallizing, the process of spraying molten metal on a surface to form a coating, is covered in this book from surface preparation to production coating techniques.

Theodolite Practice. By J. A. SANDOVER. *Cleaver-Hume Press.* (16*s*)

A practical handbook on the construction and use of the theodolite written primarily for the practical engineer and surveyor, but also suitable for examination study.

Health Physics in Nuclear Installations. Symposium organised at the Danish Atomic Energy Centre of Risø, 25-28 May, 1959. *Organisation for European Economic Co-operation, European Nuclear Energy Agency, Paris; HMSO, London.* (37*s* 6*d*)

Experience from AECL, Aldermaston, Argonne, CERN, Harwell, Ispra, Karlsruhe, KEMA, Los Alamos, Oak Ridge, Risø, Saclay and Windscale was brought to bear on the many-sided health problems in nuclear installations.

Basic Technical Electricity. By H. COTTON. 3rd edition. *Cleaver-Hume Press.* (12*s* 6*d*)

Assuming only the simplest mathematical knowledge Professor Cotton covers his subject from the nature of electricity to its industrial application. This revised edition now employs m.k.s. units.

Job Evaluation. By J. WALKER MORRIS. *Institute of Industrial Supervisors, 24 Albert Street, Birmingham 4.* (3*s*)

Determination of a fair day's work is based largely on the degree of skill, mental effort, responsibility, and physical effort involved, and the working conditions. The author of this booklet outlines the factor comparison and weighted points systems of evaluation.

Spectrochemical Abstracts. Volume 6: 1954-55. By ERNEST H. S. VAN SOMEREN and F. LACHMAN. *Hilger and Watts Limited, 98 St. Pancras Way, London, NW1.* (25*s*)

A periodical cumulation of informative abstracts covering particular substances analysed, and apparatus and techniques. A cumulative index to the first eight volumes is at present under consideration.

The Manufacture of Iron and Steel. By G. REGINALD BASHFORTH. Volume 3. *Chapman and Hall.* (35*s*)

The amount of new material and data available since the first edition of this work has necessitated the addition of a volume, devoted to steelworks fuels, furnaces, refractories and instruments.

Algebraic Theories. By LEONARD E. DICKSON. *Dover Publications, New York; Constable, London.* (14*s*)

A facsimile reprint of *Modern Algebraic Theories*, published in 1926, a university level textbook based on the author's lectures at the University of Chicago.

Mathematics, Education and Industry: A Record of a Conference of Teachers, Research Scientists, and Industrialists held at the University of Liverpool, April, 1959. *Technology (The Times Publishing Co.).* (7*s* 6*d*)

How mathematics is taught and how it is being utilised in industry and in research. Papers covered applications in chemical and electrical engineering, atomic energy, and the aircraft, textile and glass ndustries.

New Instruments and Methods of Engineering Geology. By N. V. GLAZOV and A. N. GLAZOV. *Consultants Bureau, New York; Chapman and Hall, London.* (26*s*)

A concise review of current practice in geological exploration, translated from the Russian, and particularly concerned with methods utilising radioactive isotopes.

The Reviewers

Dr. F. J. Bayley, M.Sc., A.M.I.Mech.E., is reader in gas dynamics in the University of Durham.

Mrs. Evelyn Hamilton is honorary secretary of the British Association of Women Executives.

Mr. R. A. Close, B.A., is representative of the British Council in Greece and has been a member of the Council's Permanent Overseas Service since 1939. He has specialised in the teaching of English abroad since 1933, in China, Greece, Chile, Czechoslovakia and Japan. He was member of the editorial board of *English Language Teaching* from 1957 to 1958 and has contributed extensively to national periodicals and the BBC.

Mr. N. F. Phillips is a past chairman of the Institute of Packaging and has been concerned with packaging for 36 years.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Plant and Equipment

Ladders. BARDSLEYS COLCHESTER LTD., 196 Bergholt Road, Colchester. Aluminium ladders and steps, single and extension units. Illustrated list.

Cooling Towers. MIDLAND HEATING AND VENTILATION CO. LTD., Bedford Road, Birmingham 11. Aquamiser cooling towers for use where water conservation is necessary. Aluminium, wood or spray packing; forced or induced draught. Three leaflets.

Concrete Mixers. RANSOMES AND RAPIER LTD., Waterside Works, Ipswich. Concrete mixers up to 7½ cu. yd capacity and water pumps up to 80,000 g.p.h. Leaflet.

Electrode Salt Baths. METALECTRIC FURNACES LTD., Cornwall Road, Smethwick 40. High (1,350° C) and medium (700 to 1,000° C) temperature electrode salt baths in standard sizes. Usable dimensions up to 72 in by 24 in by 24 in. Leaflet M18A.

Hot Metal Cars. HEAD WRIGHTSON TEESDALE LTD., Teesdale Ironworks, Thornaby-on-Tees. Treadwell mixer type cars for the conveyance of molten metal up to 300 tons c pacity. Description and particulars in a brochure.

Smut Control. DUST CONTROL PROCESSES LTD., 161 Clarence Street, Kingston-upon-Thames. The DCP system for the control of acidic smut emission from oil or coal fired boilers. Description given in folder.

Liquid Blender. CONSTRUCTORS JOHN BROWN LTD., Eastbourne Terrace, London, W2. The Auto-Blender electronic controller for multiple blending of liquids. Remote control apparatus and method of operation described in a brochure.

Water Softeners. HEAD WRIGHTSON PROCESSES LTD., 20-24 Old Street, London, EC1. Belco water softeners using the Headrite process with working temperatures up to 250° F. Illustrated folder gives details.

Heating Boilers. TELEGRAPH CONSTRUCTION AND MAINTENANCE CO. LTD., Telcon Works, Greenwich, London, SE10. Hot water or low pressure steam boilers working on the Möring system. Burn most solid fuels with 85 per cent efficiency. Capacities up to 9,920,000 Btu per hour. Can be converted to oil firing. Illustrated brochure TB/2.

High Temperature Furnaces. METALECTRIC FURNACES LTD., Cornwall Road, Smethwick 40. Standard range of high temperature furnaces (up to 1,400° C). Ratings up to 60 kW. Illustrated leaflet.

Box Furnaces. BIRLEC LTD., Tyburn Road, Erdington, Birmingham 24. Wide range of general purpose box furnaces for temperatures up to 1,400° C. Low voltage elements. Publication 501.

Calendar Clocks. GENERAL SIGNAL AND TIME SYSTEMS LTD., 73 Great Peter Street, London, SW1. Calendar clocks for indoor and outdoor use. Synchronous or impulse movements. Leaflet.

Dust Collector. THOMAS ROBINSON AND SON LTD., Rochdale. Suction filter dust collector type DUm; nine sizes with capacities up to 22,680 cu.ft of air per minute. Leaflet gives dimensions and ratings.

Dense Medium Washer. W. J. JENKINS AND CO. LTD., PO Box 3, Retford, Notts. Teska dense medium washers; four models with float throughputs up to 350 tons per hour. Illustrated folder.

Marketing

Mexico Orders Third AEI Power Station

THE COMISION FEDERAL DE ELECTRIDAD of Mexico has ordered a £3¼ million, 100 MW power station from ASSOCIATED ELECTRICAL INDUSTRIES, to be built at Ciudad Juarez.

BABCOCK AND WILCOX are to supply the boilers as sub-contractors to AEI; all other parts will be from AEI factories. The building design and the civil engineering are included in the contract. All the equipment is to be delivered in three and a half years, the first generating set being scheduled for completion by May of next year.

AEI have previously received two orders for complete power station plant from Mexico.

Triplex £1 Million Expansion for Production

More than a £1 million is to be spent on expanding its production capacity by the TRIPLEX SAFETY GLASS Company. This is plainly a necessary follow through from the record activities of the car makers and the expectation that ever-rising numbers of cars will leave the assembly lines.

Sir Graham Cunningham, the Triplex chairman, has said that the expansion is dependent on there being peace within the motor industry, a reference to the disturbed state of labour relations from which strikes break surface rather more frequently than in other manufacturing industries.

The new buildings and plant are due to go up over the next two years. The three main works of the company are at King's Norton (Birmingham), Eccleston (St. Helens), and Willesden (North London).

Leyland Active in the Middle East

ROLLS-ROYCE are not alone in having their engines, Conway jets in the Boeing 707, provide the power for American transport units. LEYLAND MOTORS have received a contract from a Middle East transport operator for 750 diesel engines for the conversion of American petrol-engined trucks to diesel power.

Another order from the same area will be worth £750,000 to the Lancashire heavy vehicle firm. It is for 168 Leyland Super Comet haulage trucks, 96 Super Comet tippers and 36 Clydesdale bus chassis to be built in Glasgow by ALBION MOTORS Limited.

Unilever Works Near Algiers

Not only the broad plan for the development of Algeria but some of the fine detail is becoming apparent.

UNILEVER now have the agreement of the French authorities for the establishment of a factory 15 miles from Algiers for the production of detergents, cleaning materials and cosmetics.

Construction of the works will begin this summer and it is expected that it will go into production some time in 1962. It is also known that a MICHELIN tyre factory is to be built outside Algiers.

General de Gaulle's plans for Algerian productive development are understood to include substantial increases in agricultural development and much greater output of chemicals, textiles and building materials and metal manufactures.

Since no regional development now seems to be complete without its own steelworks Algeria is to have her own—at Bône, and a French minister has recently reaffirmed that its construction is not in doubt.

Gala Year for Appliances

The fortieth annual report of the British Electrical Development Association strikes a suitably exultant note. And well it may for it is reporting on the first complete year free of restrictions on credit and purchasing arrangements. EDA contrasts the results with 1957, the last full year of the period of credit restrictions.

Three and a half times as many refrigerators were sold by EDA members, 47 per cent more electric cookers and 43 per cent more water heaters.

Not unconnected was the fact that 1959 was also the first time in many years that national advertising had been used by the Association.

The particular electrical application showing the most rapid growth was off-peak electric floor warming. This is one of those developments that benefits everybody connected with it. It improves the load factor since it is charged at night, which pleases the Electricity Boards. Operating at night it qualifies for lower cost tariffs, which pleases the house owner or office occupant.

An encouraging sign in this connection is the setting up by the Heating and Ventilating Research Association of a committee on off-peak heating to consider the thermal principles of the design of these systems and their technical suitability in relation to type, size and use of the building. The electricity supply industry is well represented on the committee.

The obvious drawback to the faster spread of off-peak floor heating is that it is only an economic proposition if it is built in with the new house. Block storage, which can be put into any building old or new, could be an all round boon if those who govern the purchase tax laws could be persuaded to remove these units from their purely industrial application.

Short lived as the period of grace free from credit restrictions may have been it will be interesting to see how far the promotional efforts of the EDA can hold up the consumer's keenness to get the labour saving switches into the house now that stiffer hire purchase terms have returned to the shops.

Lubricating Oil Refinery for Australia

The BRITISH PETROLEUM Company is to build a refinery at Kwinana in Western Australia for the production of 100,000 tons a year of high grade lubricating oil. This will be in addition to the existing BP Kwinana refinery which produces a full range of petroleum products, which from 1963 will include lubricants.

The lubricant refinery will cost about £8½ million. Work on the new project is to start later this year. The eventual output will go to the Australian market first and then to export.

Trade Tour of Latin America

Dr. Charles Hill, the minister responsible for Britain's information services, has begun a five week tour of the countries of South and Central America.

On top of inquiries into the presentation of the United Kingdom in those countries, Dr. Hill will be looking into the difficulties in the way of expanding British trade.

Since Britain's contribution to South American exports is only a fraction of our proportion of world trade, and since countries like Brazil are engaged in very rapidly increasing national production and income per head, it is worth the cause of the decline being discovered.

One stock answer is that Germany and the USA offer so much better credit terms. Perhaps more important is the spirit in which the market is approached. Dr. Hill has himself said that he must show that Britain is advanced in modern technology and is not merely a country of pageantry.

It is a relevant fact that in Brazil Dr. Hill will find our overseas car making competitors already established in local subsidiaries, employing Brazilian labour and materials to make the German and other lines of car. A profitable operation, and every car a free advertisement for the products of the country in which the local subsidiary is owned.

New Diesels to the Kent Coast

The BIRMINGHAM RAILWAY CARRIAGE AND WAGON Company, with its latest order for 21 locomotives, is now building 98 type 3 diesel locomotives of BIRMINGHAM/SULZER/CROMPTON design for British Railways.

All 98 units are to go into service with the Southern Region on the Kent Coast scheme in which electric and diesel units are to replace steam. The main-line diesels for the scheme all include electric train heating, the first time this application has been used on diesel locomotives in Britain.

The train heating current is obtained from a special generator, whose armature is mounted on a common cast steel rotor with that of the main traction generator and auxiliary generator. When train heating is not wanted the full engine power is available for traction. This feature is particularly relevant to the Southern Region's intention to utilise these units for a considerable proportion of freight train duty.

Their electrical equipment is by CROMPTON PARKINSON, and the locomotives are powered by Sulzer 8LDA28 diesel engines developing 1,550 b.h.p. at 750 r.p.m.

New Company for Petrochemical Plant

PARSONS POWERGAS, a new company for the engineering and construction of petroleum and petrochemical and related plants, has been set up in London.

The two concerns behind the new organisation are P. G. ENGINEERING Limited, a company of the POWER-GAS group, and the RALPH M. PARSONS Company, who are engineers and constructors of Los Angeles, USA.

The company's first activities will be within the British Commonwealth. Expansion into other areas may come later.

Crittall-Aquafont Resume Metal Casework

The production of standard and special metal casework is being resumed by the CRITTALL-AQUAFONT GROUP. Aquafont had a well-known reputation in this work when it was taken over 18 months ago.

The Camden Town works of the group is being equipped to handle either large or small batch production of a variety of metal and electronic casework, including cubicles, racks, instrument and tool boxes and switchboard panels.

Electric Delivery Vehicles For New York Fair

The British industrial fair in New York next month provides a springboard for the exhibition to American audiences of the specialised food delivery vehicles made at Gateshead on Tyne by SMITH'S DELIVERY VEHICLES Limited.

The company's main exhibit will be the Smith's NCB Electric "Commuter" which is designed for house to house delivery. This has a walk-through cab with sliding doors into the load-carrying part of the vehicle. Provision has been made to meet the American regulations which require the load to be fully enclosed and in some cases to be insulated.

One of the company's smaller models of mobile shops is also being shown. This is the "Routevendor," designed for grocery sales and using a new ¾ ton COMMER chassis.

The super-modern door-to-door shop offered by Smith's may perhaps find a lively market in the land of far-flung supermarkets. Service and distribution of these special vehicles in the United States is to be taken care of in future by an American subsidiary company which is to be formed.

Aviation Fuelling Plant Test Equipment

AIR BP, the BRITISH PETROLEUM Company's aviation service, has developed a special test unit for filtration and water separator equipment used in fuelling aircraft. The test rig is installed at the Tarrant Rushton airfield, near Blandfield, Dorset.

The Air BP filtration unit is able to test equipment at flow rates of up to over 500 gallons a minute. The station has laboratory facilities for the analysis of fuel samples taken after the test. The artificial introduction of solid and water contamination is used in testing equipment.

While the highest rate of flow for which delivery equipment should be designed is currently thought to be about 600 gallons a minute, consideration is being given to making the flow rate of the test rig up to 700 gallons a minute to take care of the next step in possible developments.

Radial Turbines for Small Power Plants

Using radial turbines and double-entry radial compressors, Boeing's new two-shaft small gas-turbines have an improved power/weight ratio and good fuel economy.

DETAILS have recently been given of advances in the design of small gas turbines by the Industrial Products Division of Boeing Airplane Company, Seattle, Washington. These engines are the latest in a line of development which started in 1947 with the first engine producing 100 h.p. with a specific fuel consumption of 1·8 lb per h.p.-hr. The major production effort centres on the 502 series, with outputs between 240 and 360 s.h.p. and a specific fuel consumption as low as 0·89 lb per h.p.-hr. A second group of engines, the 520 series, is currently under test.

Two basic elements make up the Boeing engines: a gas-producer section, and a power-output section. The gas producer consists of a compressor, combustion chambers, and a turbine coupled to the compressor. Exhaust gases from the turbine drive a second turbine associated with the power-output section. As there is no mechanical coupling between the turbine rotors of the two sections, their speeds may vary independently, as required by the specific operating condition. The effect is that of a built-in torque converter.

There is a considerable difference in design between the 520 and 502 series, principally in the highly stressed gas-producer stage. The 502 engines use a single-entry impeller followed by a straight-through combustion chamber; hot gases from the chamber drive an axial flow turbine coupled to the impeller; an axial flow turbine provides the output. The 520 engines use a double-entry impeller followed by a reverse-flow combustion chamber; hot gases from the chamber drive a radial flow turbine coupled to the impeller; while an axial flow turbine provides the output.

Gas producer rotational speeds have been increased. The impeller-turbine shaft of the 502 series engines operates at about 36,000 r.p.m.; that of the 520-3 operates at 43,600 r.p.m. It is this increase that is largely responsible for the rise in the power-to-weight ratio. The use of the radial design improves the durability of the turbine components.

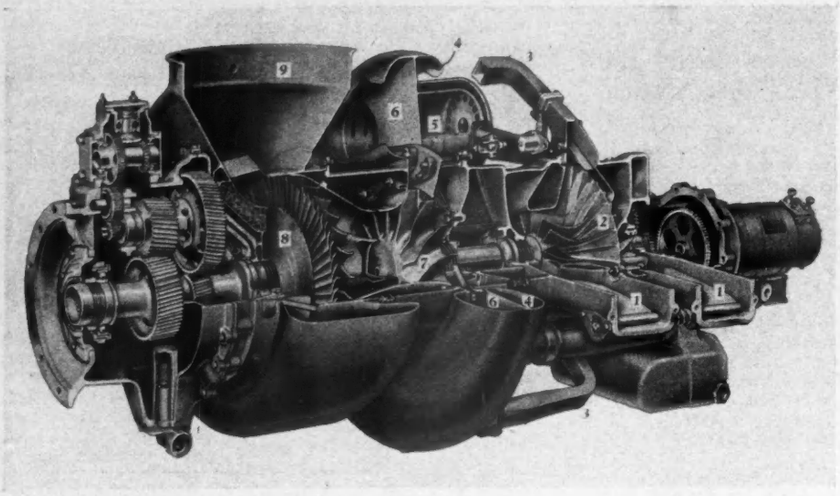


Fig. 1 Cutaway view of the Boeing 520 series engine. The 520-3 produces 475 b.h.p.

1. Inlet ducts.
2. Double-entry compressor.
3. Diffuser tubes.
4. Collector plenum.
5. Combustion chamber.
6. Inlet plenum.
7. Radial turbine.
8. Axial output turbine.
9. Exhaust Duct.

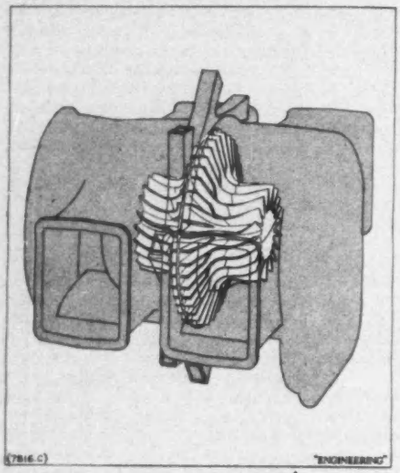


Fig. 2 A double entry radial compressor—claimed to be the highest performance single-stage compressor in operation—feeds the eight diffuser tubes.

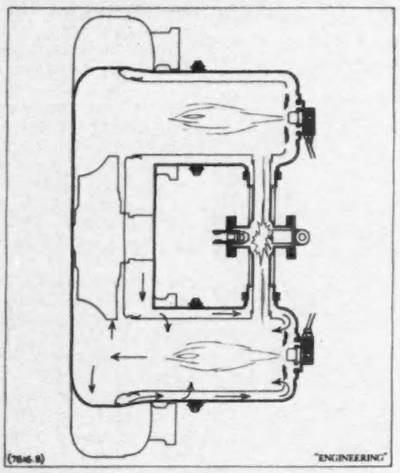


Fig. 3 Two reverse-flow combustion chambers are mounted on top of the engine for easy access. The torch igniter requires only one ignition plug.

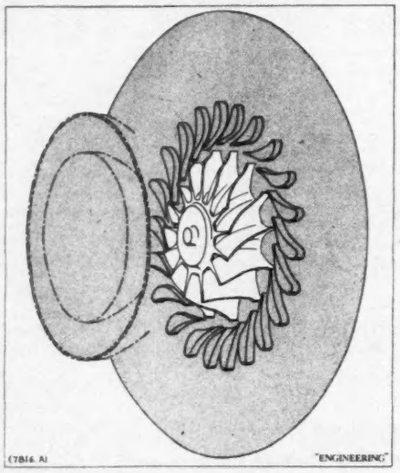


Fig. 4 The single-stage radial turbine offers durability comparable with that of the compressor, itself and also affords a simple internal aerodynamic contour.

A cutaway drawing of the 520 series engine is shown in Fig. 1. Boeing decided that minimum weight, size, and fuel consumption could be obtained with a single-stage double-entry compressor (2). Air enters through four inlet ducts (1) and passes through the vaneless portion of the diffuser at transonic speed. The air then enters the vaned portion of the diffuser and continues through eight diffuser tubes (3) to the collector plenum (4), being compressed 6½ times its original pressure. To obtain this pressure ratio, an impeller tip speed of 1,750 ft per sec is required. Boeing claim that this makes it the highest performance single-stage compressor operating today.

Air from the collection plenum enters two reverse-flow combustion chambers (5) between the burner liners and the outer shells. Some air flows directly into the burner liners through perforations designed to provide optimum turbulence and liner-cooling with minimum pressure loss. The remainder flows on between the liners and shells to the liner domes, where it reverses its direction, emerging into the combustion zones. Continuous combustion of fuel sprayed from duplex nozzles in the liner domes heats the air to operating temperature, driving it into the plenum (6) surrounding the gas-producer nozzle ring. From the plenum the gases are directed into the radial turbine (7) to drive the compressor. The single-stage radial turbine affords durability comparable with that of the compressor, while the simple aerodynamic and structural contours of the combined compressor plenum and nozzle-box assembly make for economical manufacture and maintenance. When the gases leave the turbine, their energy and pressure have been reduced by two-thirds.

The hot gases then continue to expand through the power turbine. Gases leave this turbine at nearly atmospheric pressure and at about 1,025° F, and may either be exhausted through a jet nozzle at high velocity, or at low velocity through an open duct. When running at its continuously rated power of 475 b.h.p., the 520-3 has a specific fuel consumption of 0·67 lb per h.p.-hr.

The power turbine provides essentially con-

Continued at foot of next page

Mach 3 Aircraft—Recognising the Snags

Several firms are going around saying that the only thing for airlines to buy is the Mach 3 or 3+ airliner. Certain misgivings as to the wisdom of this proposal have been expressed, however, by Mr. B. S. Shenstone, chief engineer, British European Airways. Speaking from the point of view of an airline, he suggested that the speed had not been selected by the airlines, nor was desired by them.

In a paper "Supersonic Air Transports," read at the National Aeronautic Meeting of the Society of Automotive Engineers, New York, Mr. Shenstone criticises the argument that optimum economy occurs at Mach 3 or a little higher—giving the balance between a bad lift-drag ratio and a good specific fuel consumption. "This I simply do not believe, considering the data available," he remarks. "In fact, with no great technical ingenuity, one can show that the best economics occur anywhere from Mach 1·3 to Mach 3·5; so let us forget about the special magic of Mach 3+."

Airlines are conservative. Whenever they cease to be they regret it. Successful airlines have so far increased speed as one type of aircraft succeeded another by not more than 30 to 40 per cent at a time. "How are we, the airlines, to swallow at one gulp a 350 per cent increase in speed, and, in achieving it, deal with problems of fundamental nature in structures and air traffic control without going broke?" asks Mr. Shenstone.

"It is rather puzzling to me that in most of the present literature the idea of an air transport flying at Mach 1·3 is contemptuously discarded. The impression given is that it would be hopelessly uneconomic . . . The fact that it is a practical technical job may be one of the reasons it has not loomed large in the literature where there seems to be a trend towards doing things the hard way. The Mach 1·3 aircraft can be done as an extrapolation of the classical aircraft, with either a simple swept wing or an 'M' wing."

The aerodynamic jump between the subsonic and Mach 2, and even between Mach 1·3 and Mach 2, is enormous. If at the same time a similar fundamental jump is made in materials, with the discarding of light alloy, the result is a proposal that is very difficult to sell to an airline. Consistency of product in physical properties for large sheet sizes may well be a major snag. To get consistently large flat stainless steel sheets on a production basis for the gauges required has only been tried, and not yet carried out, because there has been no demand. Until experience has been gained with the use of such materials on military aircraft it is unlikely that airlines will be willing to accept them.

Mr. Shenstone suggests that it is on the engine problem that airlines are most disturbed for Mach 3. The engines will have to be entirely new to obtain the efficiencies needed; in particular the intake problem is very difficult, even at Mach 2. There are unsolved problems of temperature and fatigue is the Mach 3 engine, the solution of which may well increase costs considerably. In some assumptions made for proposed Mach 3 engines, the cost of buying and overhauling them has been taken as no more than that of existing turbojet engines. Mr. Shenstone thinks this highly optimistic. Although mechanically they may be simpler than present engines, they will have to withstand very much higher intake temperatures and the materials required for such duty will be very expensive. "Let us be clear," he suggests, "the Mach 2 and Mach 3 transports have practically nothing in common, except perhaps superficially. The development outlays are not of the same order." For a Mach 3 aircraft it might require something like 120,000 flying hours of proving, which might well cost $60 million.

"You will gather," concludes Mr. Shenstone, "that I suspect that Mach 3+ aircraft will be found to be unsatisfactory if it is taken in one jump. So we shouldn't jump. None of us can afford to bring any supersonic aircraft into service before the early 1970's, but I suggest that even if you reach no further than Mach 2, airlines should now begin to callaborate with manufacturers while there is still time for airlines to get what they want, instead of having to take what is available."

Hydraulic Nut Eliminates Torsional Strain

The Euco hydraulic nut was developed with a view to obtaining greater pressure with low effort and at the same time to eliminate the torsional strains which are present when tightening a nut in the conventional manner.

In one test a 1 in BSF hydraulic nut was screwed on hand tight, and the initial pressure registered ¼ ton per sq. in. The hydraulic pressure was then applied by turning the $\frac{5}{16}$ in pressure screw with an Allen key, raising the pressure to 4 tons per sq. in. This increase was therefore obtained with an applied force from finger and thumb. Removal of the nut was just as effortless; the pressure screw was unscrewed to release the pressure and the nut removed by hand.

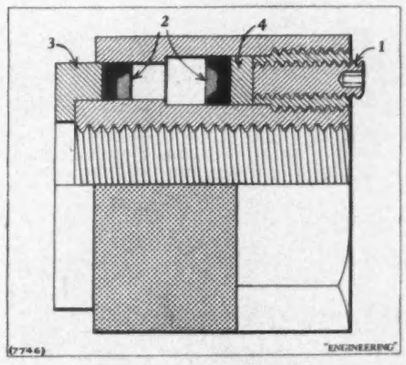
A further test was made by screwing the nut on with a spanner to provide an initial pressure of 1 ton per sq. in, the hydraulic pressure was then applied as before and the pressure rose to 5 tons per sq. in.

The body of the hydraulic nut is made from high tensile steel and an annular recess is formed in the front face. The recess communicates through a bore to the back face of the nut, the bore being threaded to receive a reducing bush which accommodates the pressure screw (1). The recess and bore are filled with a special compound and enclosed with seals at (2). A thrust ring (3) fits in the recess bearing against the front seal while a pressure pad (4) bears against the rear seal and transmits the pressure applied by the screw (1).

The hydraulic nut is already being accepted by the engineering industry as the answer to many problems, typified by the following. The two halves of a main bearing for a large diesel engine required clamping together for a precision boring operation. The size of the two clamping bolts was 12 in long by 2¼ in diameter and the nuts required to be tightened with considerably more than normal pressure. This was previously obtained with a special low geared mechanical nut runner which was expensive, cumbersome and laborious to operate. The work is now undertaken more quickly with two hydraulic nuts and at a fraction of the previous cost.

A gang of 4 circular cutters were clamped together on an unkeyed spindle for a machining operation. Insufficient clamping pressure resulted in the cutters frequently slipping under the cutting load. This trouble was eliminated by using a hydraulic nut.

Sizes range from ¾ to 2 in diameter and are available with Whitworth, American, Unified and metric threads, obtainable from Euco Tools Limited, 44 London Road, Kingston-on-Thames, Surrey.



The Euco hydraulic nut.

Concluding **Radial Turbines for Small Power Plants**

stant power over one-third of the output speed range for any selected compressor speed. For applications in which the torque is independently varied, but control over the power turbine speed is desired, a power-turbine governor is used which sets the demand speed for the gas-producer speed governor.

Speed control of the gas-producer section is by a governor associated with the engine-driven fuel pump, which supplies fuel under pressure to the burners. An acceleration limiting device, which controls the fuel nozzle pressure during rapid movement of the throttle to limit the rate of acceleration of the gas producer, is incorporated in the fuel system.

Both rotor assemblies are proportioned and supported so as to prevent the generation of destructive vibration by designing the first-order natural-frequency modes to occur above the highest operating speed. The radial and thrust bearings of both main rotors support the applied loads on hydrodynamic films; any rotor-mass eccentricities produced by assembly tolerances and normal operational rotor-blade deterioration are absorbed within the radial-bearing clearances provided.

Latest in the 520 series is the 520-3, a general purpose power plant for marine and surface use, supplementing the 502 series which has found application in marine, industrial, vehicle, and aircraft fields. (About 250 of the 502 engines were built to drive generators on minesweepers.) The 520 series is designed as a lightweight power plant for helicopters and business aircraft, and for such surface applications as freight trucks and fire boats.

The 520-3 has a continuous rating of 475 b.h.p. at an output shaft speed of 2,950 r.p.m. Its dry weight is 340 lb. A considerable increase in power to weight ratio has therefore been achieved over the 502 series. The 502-10C, for example, has a rating of 240 b.h.p. and a dry weight of 320 lb. As far as overall dimensions are concerned, the 520-3 is about 1½ in higher, 1½ in wider, and 22 in longer than the 502-10C.

Fan-Cooled Hubs for Safer Aircraft Braking

A small fan, driven by a fractional horse-power electric motor, is now being incorporated in the wheel hubs of modern commercial aricraft. The aim is to achieve a quicker turn-round of aircraft, and also to reduce the risks of brake failure and tyre bursts.

With heavier aircraft and higher landing speeds, the problem of dissipating heat generated in braking systems has caused delays in aircraft turn-round of up to two hours. The high temperatures generated have also damaged tyres and oil seals and caused brake failure on subsequent take-off if cooling is insufficient.

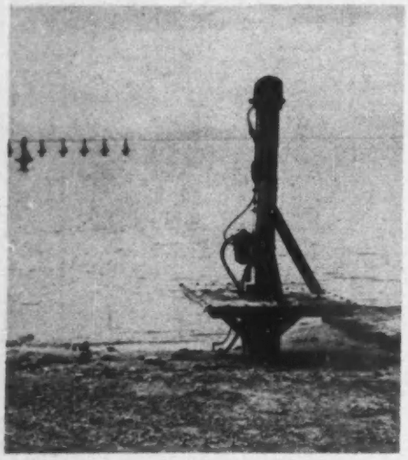
Now, with forced ventilation by the fan, designed and manufactured by the Airscrew Company and Jicwood Limited, of Weybridge, Surrey, which is used in the new air-cooled brake designed by the aviation division of the Dunlop Rubber Company Limited, aircraft turn-round time is said to have been cut by 80 to 90 per cent, and the other hazards completely removed. Test results have shown that cooling time can be reduced from 100 minutes to 13 minutes.

A minimum of modification to existing brake units is necessary and the new system is being fitted to all Comet IV aircraft. The illustrations show the wheels fitted with cooling fans.

(Left) Air-cooled brakes fitted to the landing wheels of a Comet IV aircraft lose heat rapidly, so reducing the risk of brake failure and tyre bursts.

(Right) Forced ventilation in the braking system is provided by a motor-driven fan. The cooling period is reduced from 100 minutes to as little as 13 minutes.

Lighting Jamaica's Palisadoes Airport



(Left) At the west end of the runway, which juts out into Kingston harbour, the approach lights have been mounted on piles sunk into the sea bed.

(Right) Night view of the west approach and runway lighting at Jamaica's new airport. Built on a 8,600 ft strip of reclaimed land, the runway has been designed to take aircraft of the Boeing 707 size.

Jamaica, a focal point in United States-Caribbean air services, is building a new airport on the Palisadoes peninsula to take aircraft of Boeing 707 and Douglas DC8 size. The site is next to the old airport, which is now inadequate for modern aircraft. The new 7,600 ft long runway and main taxiway, constructed on a strip of reclaimed land projecting 8,600 ft into Kingston Harbour, are already in operation, and the terminal buildings and apron should be completed by 1961.

So that the airport can be kept fully operational 24 hours a day, the General Electric Company, of England, has supplied a comprehensive airfield lighting system, which has been installed in collaboration with Barlow and Young Limited, at a cost of about £60,000.

The lighting installation comprises: low-intensity runway, threshold and approach lighting, taxiway lighting, a location beacon, two illuminated wind cones and obstruction lights, together with the necessary switchgear, transformers, control equipment and cable.

Spaced at 200 ft intervals along each side of the runway are ZA205 low-intensity elevated runway lights, fitted with 45 watt 6·6 amp. tubular lamps. These lights are omni-directional and have a maximum intensity of 450 ft-candles. The lights of the first and last thirds of the runway are equipped with 180° amber filters for range indication.

To minimise damage to an aircraft if it collides with the lights, the overall height above ground of the fittings has been kept down to 10½ in and the mountings incorporate a weak link.

The runway lights are supplied with current by two separate interleaved series ring circuits, each circuit being fed by a substation at either end of the runway. If one circuit should fail, the lighting pattern will be maintained but with alternate lights only (i.e., at double spacing).

Each light is fed by a series isolating transformer, the primary windings of all transformers on a circuit being connected in series on the ring cable. As the output voltage of the isolating transformers is low, lamps or fittings can be replaced safely while the circuit is live.

The threshold lights, ten at each end of the runway, are of the same type as the runway lights but are fitted with green filters and have asymmetric refractors to concentrate the beams up and down the runway.

Consultants for the runway, taxiways and traffic apron, and the airfield lighting system are Sir Alexander Gibb and Partners, while the new terminal buildings are the responsibility of the architects, Norman and Dawbarn.

Evolving High Speed Railway Drawgear

As part of the British Railways modernisation plan, research and development work has been undertaken to produce improved buffers and couplings for freight trains.

SPEEDY transport is an important factor in the modernisation plan of British Railways. Fast running means that maximum use is made of line capacity, turnround of locomotives is increased, wagons and train crews are used more efficiently.

The task now facing the British Transport Commission is the equipment of all wagons with continuous brakes, modern buffers and automatic couplings. There is the very difficult physical problem of fitting continuous brakes to a wagon stock which will probably amount to three-quarters of a million by the time that the plan has been completed. This is closely related to the supply of components from manufacturers and the provision of adequate workshop capacity. The entire programme, however, is completely dependent on the rate at which vehicles can be released from traffic. Any one of these three vital requirements may become decisive in determining the rate of progress.

Release of wagons demands very careful judgment, because there must always remain enough vehicles of every type available for current traffic needs; determination of priorities is not made any easier by the fact that those vehicles most readily available are less likely to carry a high priority for brake fitting. The age, wheelbase and other structural features must be studied, because these will determine the suitability of rolling stock for high speed running. As the programme gathers momentum, and its cost will not be less than £125 million with annual charges of more than £9 million, the higher turnround resulting from a higher proportion of fitted wagons will make release easier, but this will not count for much until the programme is well advanced.

If goods trains are to run at high speed, however, it is essential that they must be fitted with modern (hydraulic) buffers and automatic couplings as well as with continuous brakes. In this connection, a full scale research programme is now being conducted by Dowty Hydraulic Units Limited, Ashchurch, Gloucestershire, and some very valuable practical results have been achieved.

The standards for conventional railway buffing gear were laid down many years ago, when traffic was a mere fraction of what it is today and when shunting speed was less than three miles per hour. The pressure of modern railway traffic has greatly increased shunting speed and although 10 m.p.h. is now common, higher speeds often occur; but buffing equipment has not kept pace with this speed-up. Hump marshalling yards have emphasised the problem, for in them wagons are subjected to greater impact shocks than ever before; orthodox spring buffers, which in the old days gave adequate protection against shock, are now sadly out of date.

Any increase in the shock absorbing capacity of conventional spring buffers cannot be provided without exceeding space limitations, or without building the wagons on much more robust lines to withstand successfully the much harder operating conditions. Cost of new wagons has thus been increased, and although their increased strength does protect them against rough usage, this has had no effect on the damage to goods, leading to claims for compensation which amount to a considerable sum each year.

IDEAL BUFFER

It was with these thoughts in mind that the Dowty hydraulic buffer (see Fig. 1) was developed, employing a completely new operating principle to provide adequate shock absorption within the travel limitations imposed. Although of low unit cost, this buffer has more than 20 times the shock absorbing capacity of conventional gear, even at normal shunting speeds. Furthermore, it is an extremely simple and robust unit with a minimum of working parts, an essential criterion for all railway equipment. It gives reliability with little or no maintenance, operates efficiently over a wide range of wagon weights, and compensates for differing impact speeds by providing the minimum reaction necessary to change wagon velocity. Nearly all the energy is dissipated by the buffer so that recoil is steady and controlled, with no secondary impacts caused by high recoil loads. At full closure the piston is finally arrested by the hydraulic fluid column, thereby avoiding harsh metal-to-metal contact.

The extra cushioning thus provided has led to reduced wagon maintenance charges and insurance damage claims. It has also opened the way to lighter and larger new wagons, with obvious financial advantage. Basically, the Dowty hydraulic buffer comprises a combined reservoir and cylinder, housing a piston loaded by a helical steel spring. On impact, fluid is displaced by inward movement of the piston into the surrounding reservoir through orifices in the cylinder wall. The restriction imposed on the oil flow causes a back pressure which reacts on the piston to give the buffer its resistance to closure. The fluid capacity is about ten pints, and tests have proved that the fluid loss is only about 70 c.c. after 5,000 heavy impacts.

An ideal buffer should give uniform resistance throughout closure, and when the buffer is fully home all the energy of shock should have been absorbed. Thus the forces acting on the vehicles are kept at a minimum within the closure available. Hydraulic buffers can be designed to give a performance closely approximating to this ideal. From the wagon design aspect, with which this research is closely linked, the most important feature of buffer performance is the maximum reaction expressed in multiples of g (the acceleration of gravity) which will occur during impact.

In this research, the performance of the buffer as a shock absorber is evaluated by shunting a test wagon of known mass into a solid concrete stop and taking recordings of the pressure generated, buffer closure and impact speed with electronic equipment. When a wagon collides with a stationary vehicle of equal weight, the energy to be absorbed is half the kinetic energy of the moving wagon at the moment of impact; when a wagon runs into a solid stop, all the kinetic energy of the vehicle is destroyed. If the energy is absorbed by two pairs of impacting buffers, the test vehicle will have half the mass of the wagon whose shunt into another wagon is being simulated. If the energy is absorbed only by one pair of impacting buffers, the mass of the test wagon will be a quarter of that of each vehicle involved in the wagon-to-wagon impact. Buffer performance can therefore be evaluated without the need of fully laden wagons and this research technique also eliminates vibrations due to load movement.

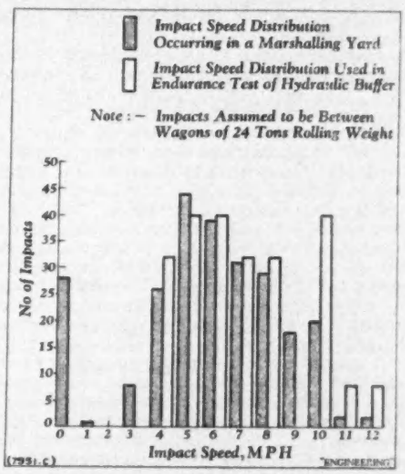


Fig. 2 Comparison of impact speed distribution used in endurance test of hydraulic buffer with that occurring in a marshalling yard.

The energy to be absorbed when wagons impact, is given by

$$E \text{ (energy)} = \frac{W_1 W_2}{W_1 + W_2} \cdot \frac{v^2}{2g} \quad \text{- (1)}$$

where W_1 and W_2 are the weights of the two vehicles and v is the relative speed at the moment of impact. If both vehicles have the same weight, then, obviously,

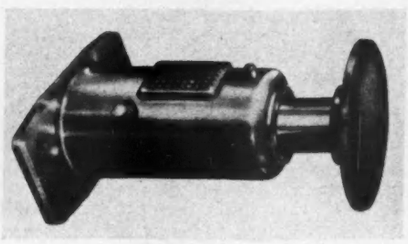
$$E = \frac{W v^2}{4g} \quad \text{- - (2)}$$

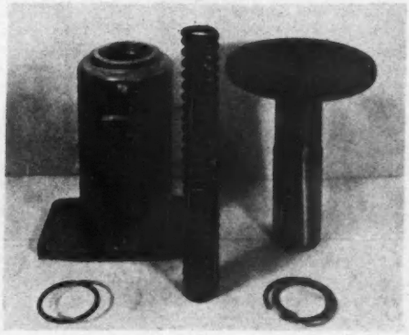
In service, however, the shock is absorbed by two pairs of buffers, so that in the case of impacts between wagons of the same weight, the energy to be absorbed per pair of impacting buffers is

$$\frac{W v^2}{8g} \quad \text{- - - (3)}$$

Since the hydraulic buffer is sensitive to speed, the rate of closure in the test must be equal to the rate of closure of a wagon-to-wagon impact. This condition therefore determines the speed of the test shunt into a solid stop. The weight of the test wagon and the number of buffers absorbing the impact are adjusted so that the energy absorbed by each buffer will be the same as that in the actual shunt simulated by the test. The table shows how adjustments have been made,

Fig. 1 The Dowty hydraulic buffer. Below, complete for mounting on a wagon. Right, dismantled, showing all the components.





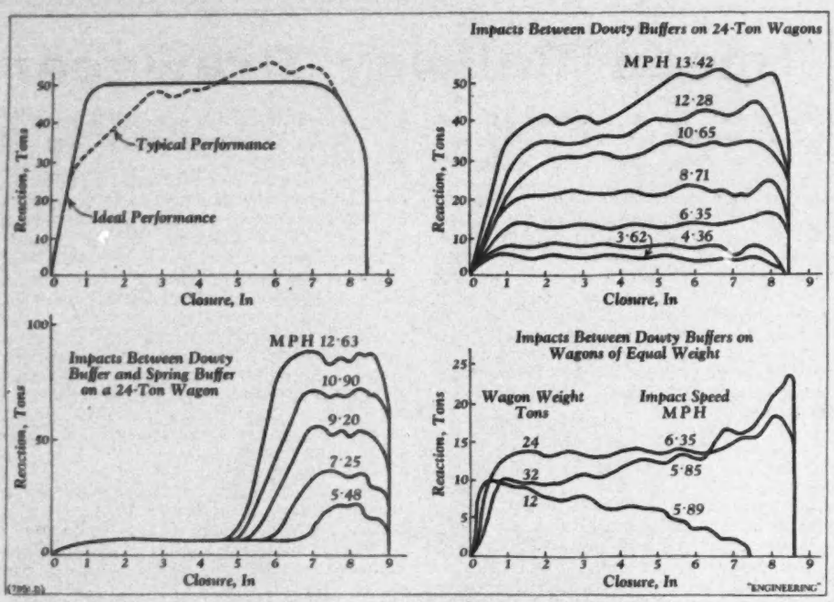


Fig. 3 Impact test results on Dowty hydraulic buffers.

bearing in mind that all the kinetic energy of the wagon is absorbed in an impact with a solid stop.

MEASURING BUFFER REACTION

The data required during buffer testing are as follows: the speed of the wagon at the beginning of impact; the weight of the wagon; the variation in the reaction of the buffer as it closes, and the total closure of the buffers. From the first two is obtained the kinetic energy of the wagon and hence the energy to be absorbed; from the other two items the reaction/closure curve of the buffer can be drawn. The area enclosed by this curve, together with any energy stored in a recoil spring, will give the energy absorbed in the buffer.

A research method of measuring and recording variation of buffer reaction has been developed by the aircraft section of the Dowty Group. This is measured as change of pressure in the hydraulic fluid in the buffer mounted on the stop. This is the true reaction, since the Dowty buffer is designed to " bottom " on the oil under pressure; there is no metal-to-metal contact at the end of closure. Into a tapped hole in the end wall of the pressure chamber is screwed a strain gauge pressure pick-up. Manufactured by Southern Instruments, Limited, this unit consists of a small cylinder upon which is wound a strain gauge; the cylinder dilates under pressure, increasing the electrical resistance of the gauge.

This gauge has been designed for pressures ranging from zero to 16,000 lb per sq. in. It is calibrated before tests by the Dowty mechanical test department. During testing the strain gauge is part of a Wheatstone bridge circuit. Voltage changes produced during an impact are fed initially to a direct current pre-amplifier and then into the driver amplifier of the first channel of a cathode ray oscilloscope, also made by Southern Instruments. The movement of the electronic beam resulting from a change of pressure in the buffer may be calibrated by switching a fixed resistance into the bridge; the step produced in the trace is equivalent to the calibration pressure of the gauge, or 7,980 lb per sq. in. The movement of the cathode ray beam is recorded on sensitised paper run through a camera fitted to the electronic apparatus.

The motion of the wagon, and hence closure of the buffers, is recorded on the second channel of the cathode ray oscilloscope. A potentiometer, in which the sliding contact is fitted to a probe, is mounted on the stop block so that the probe first makes contact with the wagon 6 in before the buffers meet. Just as they touch, this sliding contact is arranged to coincide on the potentiometer winding with a fixed contact, which changes polarity of the voltage after the slider has moved past this point.

The time signals of these traces is obtained by feeding signals at intervals of 1/200 sec from an oscillator controlled by a tuning fork into a third cathode ray oscilloscope, recording the pulses simultaneously with the signals from the first two channels. The impact speed is obtained by dividing the 6 in initial probe movement by the time interval in which this takes place. By drawing common ordinates on the pressure and closure traces, and multiplying the ordinate for each trace by its respective scale, a curve of pressure against buffer closure can be drawn; this is the buffer reaction. Fig. 2 shows a statistical summary of research results, and Fig. 3 the curves obtained.

The development of an automatic coupling for British Railways wagon stock has been directed at meeting various important requirements. This coupling is designed as an automatic connecting device for drawgear and brake pipes for standard wagon stock, and it must be capable of a drawbar pull of 100 metric tons, the Standard laid down by the Union Internationale des Chemins de Fer (UIC). Fig. 4 is a sketch of the Dowty coupling in the closed position.

The design of this coupling is circumscribed by the fact that it must be identical on each end of the wagon and be compatible with existing rolling stock. Buffers for use with the coupling will project 24½ in from the wagon headstock and have to be compressed ½ in to meet the close-coupled requirements; allowance must also be made for the remaining 4 in of buffer closure. The coupling must accommodate a combined misalignment of one vehicle relative to another amounting to 5 in in the vertical plane and of 6 in in the horizontal plane.

The wagons must be able to negotiate a hump of 7 chains (462 ft) radius and a reverse curve of 5 chains (330 ft) radius, as well as a horizontal curve of 1½ chains (99 ft) radius. It must be possible to uncouple the coupling from either side of a train in such a manner that the coupling is directly engaged or that it is set for marshalling. In the event of accidental breakage of a drawgear, the brake connection must part in such a manner that it will preserve the fully automatic action of the brake. When vehicles are intentionally uncoupled, a method of shutting off the vehicle brake pipe must be provided.

The vacuum brake pipe connection must remain airtight under British operating and climatic conditions for long periods without the need for maintenance. Any routine servicing or replacement which may be necessary must be of the simplest nature, within the capacity of outstation staff and resources. Finally, the device must be of simple yet robust construction with low capital and maintenance costs. In addition, however, users must be able to weigh wagons even when they are coupled; it must be possible to separate or connect wagons at small depots and branch lines; to connect them to passenger stock; to use them with mechanical handling plant.

TABLE.—*Comparison of Actual and Simulated Shunting Conditions*

Actual shunting conditions			Equivalent test conditions			
Weights of impacting wagons (tons)	Speed of impact	Energy per pair of buffers $\left(\frac{W v^2}{8g}\right)$	Speed of impact with solid	Weight of test vehicle (tons)	No. of pairs of buffers	Energy per pair of buffers
32	v	$4v^2/g$	v	8	1	$4v^2/g$
24	v	$3v^2/g$	v	6	1	$3v^2/g$
12	v	$1{\cdot}5v^2/g$	v	6	2	$1{\cdot}5v^2/g$

MATCHING EXISTING EQUIPMENT

The problems involved in this research were extremely complex, since the geometry of the coupling is severally restricted by the need to work in conjunction with existing designs and sizes of wagons, buffers, and couplings. The research therefore advanced through various

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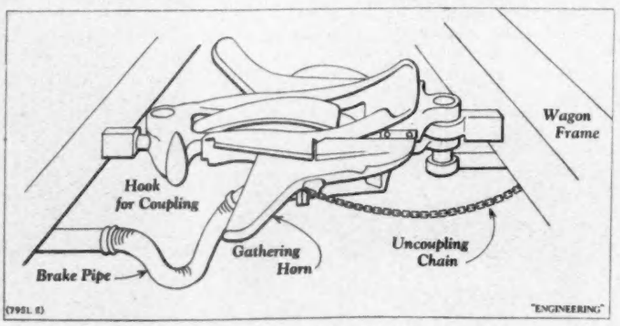

Fig. 4 The Dowty automatic coupling in the closed position.

More Light on Air Bearings

The use of high-pressure air as a bearing medium for precision moving parts is growing because, compared to conventional bearings, they are easy to manufacture, they are practically frictionless, and they do not wear.

It is because of these outstanding advantages that they have recently been used by the National Engineering Laboratory in the development of several types of precision measuring instrument.

One example of this work is a roundness measuring machine in which an air lubricated journal bearing provides a precision axis of rotation for the measuring head. Movement of this axis is within a circle of ten microinches diameter, even though the journal and bush have not been manufactured with particularly high accuracy. Another example is a flat air bearing for a saddle which has to move accurately in a straight line along a precision girder, without sticking. On air bearings, the saddle was found to have considerably less yaw, pitch and roll than when mounted on precision ball bearings. The saddle and girder form part of a machine for automatically measuring pitch errors on precision lead screws.

Experiments with flat air bearings have shown that the maximum static load that can be carried is approximately one-third of the product of the bearing area and the air supply pressure. Formulae have been deduced from which bearing area and size of orifice can be determined for a given load and air gap. At the same time, bearing stiffness and air flow may also be calculated.

Another type of air bearing currently being investigated by NEL is one which is self acting; that is to say, air is drawn in by rotation of a shaft, thus generating a load carrying air film by hydrodynamic action. However, because air has a low viscosity, the loads that can be carried this way are small, unless the shaft is running at high speed. For instance, with a conventional bearing clearance, the maximum load that can be carried by a 1 in diameter shaft running in a speed range of 30,000 to 50,000 r.p.m., is about 1 lb per sq. in of bearing area for every thousand r.p.m. The characteristics of this type of air bearing are not yet fully understood, and investigations are being carried out at NEL to help in providing data for their design.

Further information on the subject of air bearings is given in NEL Report Mech/Met 132, entitled "Air Bearings—Research and Applications at NEL," by M. Graneek and J. Kerr, and available from the director, National Engineering Laboratory, East Kilbride, Glasgow, Scotland.

Optimum Power for Electrical Steelmaking

Heat transfer during the melting phase of the electric steel making cycle has been the subject of an investigation carried out by the British Iron and Steel Research Association. The effects of furnace voltage and power input on electricity consumption, melting time and refractory temperature have been considered and this has enabled the optimum power input programme for the melting period to be specified.

This optimum programme has been tried out on the BISRA experimental arc-furnace by means of an automatic power input controller and has resulted in a saving of electricity of 13 per cent and a reduction in melting time of 8 per cent, when compared with the conventional procedure. Trials have shown that the trends observed on the BISRA furnace also apply to a five ton production furnace, where it has been possible to reduce electricity consumption without any loss of output.

Interest in the control of power input by measurement of roof temperature has been increasing and several BISRA member firms have been successful in doing this, using total radiation optical pyrometers. Furthermore, a method of measuring the rate of rise of the roof temperature has been developed by an instrument firm and this method is now undergoing trials on the BISRA arc-furnace. With this technique, the rate of roof temperature rise is used to indicate that power is being dissipated wastefully, a signal is then given to an automatic power controller which reduces the power by shortening the arcs. This has the effect of reducing the heat loss to the refractories, while still supplying heat to the metal.

In large arc furnaces severe wear at the side walls is more common than severe roof wear, and it is reported that several member firms of BISRA have asked for assistance in determining the temperatures of inside walls. Tests have been made with thermocouples but, since the life of refractory sheaths is so short, it has been decided to concentrate on the development of a conductive type of heat flow meter, and tests so far have given promising results.

Field trials have been conducted to determine the electrical characteristics of five different production furnaces with capacities ranging from 5 to 25 tons. The work has shown that in three cases the supplementary reactance in the furnace circuit was higher than necessary. If these were reduced it could lead to an improvement in the furnace performance.

The very low sulphur contents that are now being demanded for the steel used in electric arc-furnaces are either difficult to obtain or need excessive periods under reducing slags where hydrogen is picked up by the metal. It was shown some time ago that sulphur contents less than 0·01 per cent could be quickly attained by injecting basic material in powder form beneath the metal after the reducing slag had been removed. It has now been demonstrated on the experimental arc-furnace that there is no need to remove the reducing slag. Rapid desulphurisation can be achieved by injecting basic materials, to the extent of some 10 lb per ton. Lime, calcium carbide, calcium cyanamide and calcium silicide have all been tried, but the best materials seem to be the lime magnesium mixtures and calcium silico-magnesium alloy. The superiority of these materials is probably due to their strongly deoxidising nature, which is known to help desulphurisation. In the experiments nitrogen has been used as the carrier gas, but where this would give rise to undesirable absorption, argon could be used. Works trials are now to be made to assess the suitability and economics of the procedure.

The above information is contained in the latest annual report of the British Iron and Steel Research Association, whose head offices are at 11 Park Lane, London, W1.

Concluding **Evolving High Speed Railway Drawgear**

stages, using methods and materials most suitable for rapid production of prototypes.

Fig. 4 shows the general arrangement of the design finally evolved, in which the gathering horns are disposed at an angle of 45° to the vertical and have an included angle of 120°. The function of these horns is to guide the two halves of the coupling together when the wagons make contact; as soon as the parallel centre portion is located, the latches mutually engage and are then locked into position. As soon as these latches are engaged, the vacuum brake pipe connectors are forced together and are later kept in proper alignment by the main components of the coupling.

OPERATING LIMITS

The main coupling member is universally mounted at the end of the drawbar to allow ample movement during the gathering action, simultaneously providing the necessary flexibility for travelling around sharp curves and over humps. A further very important feature is the ability of the coupling to be pivoted through a horizontal angle of 77°, thus presenting a normal drawbar hook. In this condition, it may be used with any three-link or screw-type couplings.

Research was undertaken to elucidate certain important features for which the geometry and mechanics could not readily be calculated. The main points of interest are: the ability of the couplings to "gather" together; to latch and lock securely; to provide adequate vacuum connection; to negotiate points and curves; and to be readily unlatched by hand.

Satisfactory automatic coupling was achieved at impact speeds ranging from 2 to 8 m.p.h. with the impacted wagon both braked and free; during these tests, offset conditions were simulated by arranging the couplings in unnatural positions. The research engineers thereby satisfied themselves that the coupling horns would successfully gather over a rectangle equivalent to an offset of 6 in both vertically and horizontally. In each case the manual unlatching operation was carried out successfully from the side of the wagon; tests were also made with the coupling in the marshalling position, proving that there was no risk of the latches becoming engaged.

It has been proved that the coupling will negotiate a curve of 1½ chains (99 ft) radius; under this condition the buffers on the inside of the curve are fully compressed, for which reason it is not possible to couple up on this curve owing to speed restriction, although it is possible to uncouple. Tests also proved that automatic coupling could be achieved on a curve of 2½ chains (155 ft) radius without difficulty. On a 2 chain radius curve it was not possible to couple with the available locomotive power in the test shunting yard.

MINIMUM CURVES

The limiting condition appears to be a curve of 1 chain (66 ft) radius, for on this the inner buffers are fully compressed and the same applies to the drawbar springs; even under this extreme condition, however, the coupling could be unlatched by hand without much effort. Negotiation of this curve is possible with the wagons coupled; on one occasion, however, owing to the high speed of the locomotive, the leading wagon was derailed, with the result that the coupling assumed an extreme angle. Nevertheless, it was possible to unlatch the coupling from the side of the wagon in the normal way.

The most practical test to determine whether a satisfactory joint has been made in a vacuum pipe is to measure the time taken for internal pressure to rise by leakage into the system. Tests have revealed that the performance of the Dowty connector equals that of the standard British Railways coupling.

At Home

On the Tape

LITTLE more than 15 years ago magnetic recording was a technical curiosity; now tape recorders are being sold to all and sundry at the rate of many thousands per week.

Early recordings were mostly made on wire, it being the only material available which could be magnetised. Some machines still use this method which has some special advantages, notably the amount of wire that can be handled in a small space. It also has disadvantages in the event of breakages—and the resulting " bird's nest " has to be seen to be believed. But nevertheless almost all the pioneering work was done on wire, including the development of the recording head and the driving motors for the spools. The later change to a plastics tape with a magnetic coating was a small revolution in itself.

The basic principle is that a magnetisable material is made to pass an electromagnet, the strength of which varies according to the signal fed to it. This signal is derived from a microphone picking up vocal or musical vibrations and converting them to electrical impulses. According to the degree of field strength of the head so the magnetism of the wire or tape is varied, and when the same tape passes back over a pick-up coil the action is reversed: an electric signal is induced in the coil which is converted to sound by an amplifier and loudspeaker system.

On a slow moving tape the signals will come very close together so the resulting record will (in extreme examples) be blurred. Conversely the higher the tape speed the more space each signal will have, and the better will be the discrimination possible by the pick-up coil. As ever, of course, a compromise is necessary to balance the quality of the reproduction against the amount of tape to be handled. Standard speeds nowadays are 7½, 3¾, and 1⅞ in per second. The last is generally confined to speech recordings. A few machines designed for high fidelity work have an additional speed of 15 in per second.

The use of recorders has rapidly extended to almost all fields both of pleasure and industry. The size range has also grown. One of the smallest made is the Minifon, shown in the first illustration; it weighs just over 2 lb and holds a cassette of tape that will give 30 minutes recording. Among the largest is the Ampex shown in the other illustration; this is the type used for recording broadcast television shows. In between are sizes to suit all purposes (and most pockets).

The Minifon Attaché (illustrated) is a dictating machine measuring 4 in by 7 in by 1⅜ in. The tape is carried in a cassette that slips directly over the driving spindles and can hold enough for 30 minutes' recording. Reversing the cassette allows the second half of the tape to be used—a common device in tape recorders—giving a full 60 minutes time for the same total length of tape. The cassettes are interchangeable with the Office machine which, though transistorised like the Attaché, is mains operated.

Another version of the Minifon uses wire. for the recording medium and offers a running time of 5 hours. The dimensions are slightly less than those of the Attaché and the weight is 2 lb 2 oz.

The Ampex machine will record for replay a full television programme and can be equipped for full colour as well as black and white. The model C (illustrated) is both smaller and lighter than earlier machines and has better quality. It is fitted with a signal synchroniser that allows switching from one tape to another; from tape to live; and from tape to film without loss of picture. Spilt screen effects, dissolves, wipes and mixing can be imposed on a single tape without splicing.

In the home, tape recorders are used for an almost infinite variety of purposes. Recording of music ranks very high and the quality of such records can be extremely good. Some machines have facilities for imposing on top of an existing recording, while most allow for simultaneous recording from microphone and radio. " Editing " of tapes is a simple matter (even a single word can be cut out if desired) so that artistic compositions can be produced. No wonder that there has been formed a club for enthusiasts and that tapes of items are now almost as available commercially as the ordinary gramophone record. Tape services are in existence for the sick and blind covering, apart from music and entertainment, such items as personal messages from home and overseas and a reading circle of books and extracts from newspapers and periodicals. These services operate in conjunction with the British Recording Club.

Outside the home, tapes have taken over control of machine tools and many automatic processes. They appear in guided missiles and for railway station announcements. They even record telephone messages while you are away. The thickness of the plastics base has been progressively decreased so that more and more can be wound on the same diameter spool,

On the right is the Minifon, one of the smallest tape recorders; below is an Ampex for colour television work.

but the greatest compactness is forecast for a new method developed by the General Electric Company of America using a thermoplastic recording. A beam of electrons impinges on the tape imparting a magnetic pattern. The tape is then slightly melted and the charged parts are attracted to the base leaving the uncharged portions sticking up in the form of a series of wrinkles. Television cameras can record directly on to it and the replay can be immediate without any chemical processing. It is estimated that the entire contents of the *Encyclopedia Britannica* could be recorded on a roll the size of a crumpet. The record made is permanent but can be erased by re-melting.

The Minifon is sold in this country by EMI Sales and Service Limited, 363 Oxford Street, London, W1, and the Ampex is made by Ampex Electronics Limited, Arkwright Road, Reading. The offices of the British Recording Club are at 145 Fleet Street, London, EC4.

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Published every Friday by Engineering Ltd. at 36 Bedford Street, London, WC2, England.
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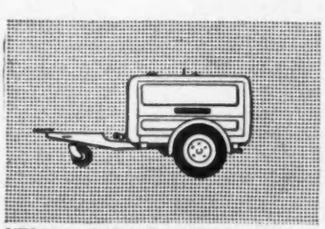

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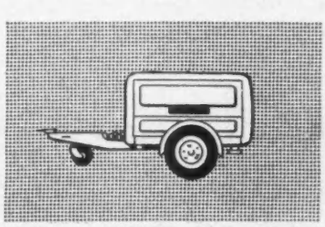

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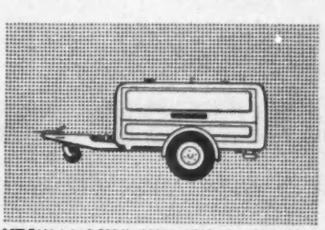

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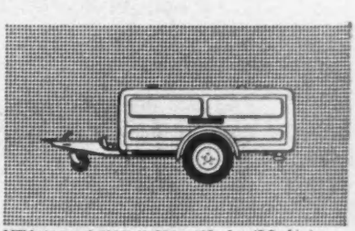

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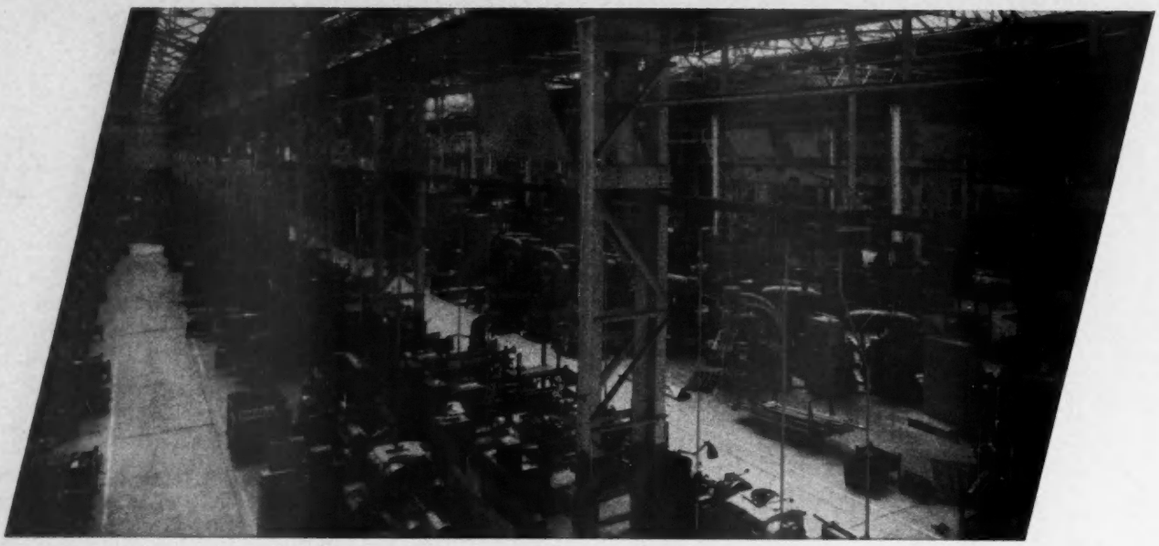

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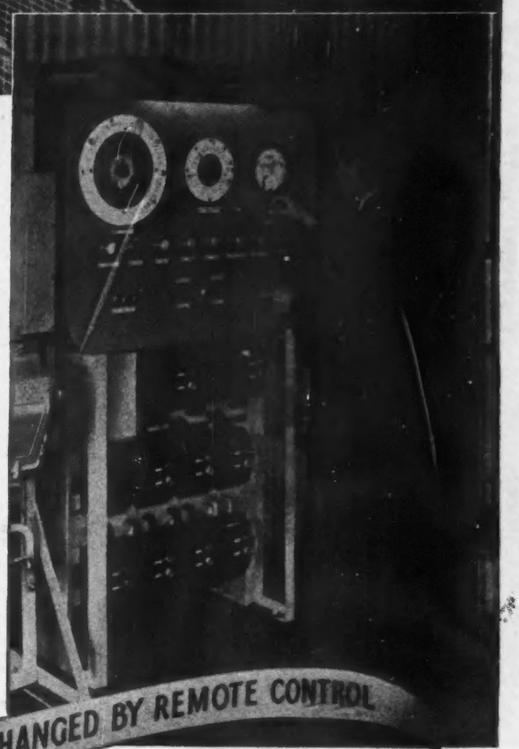

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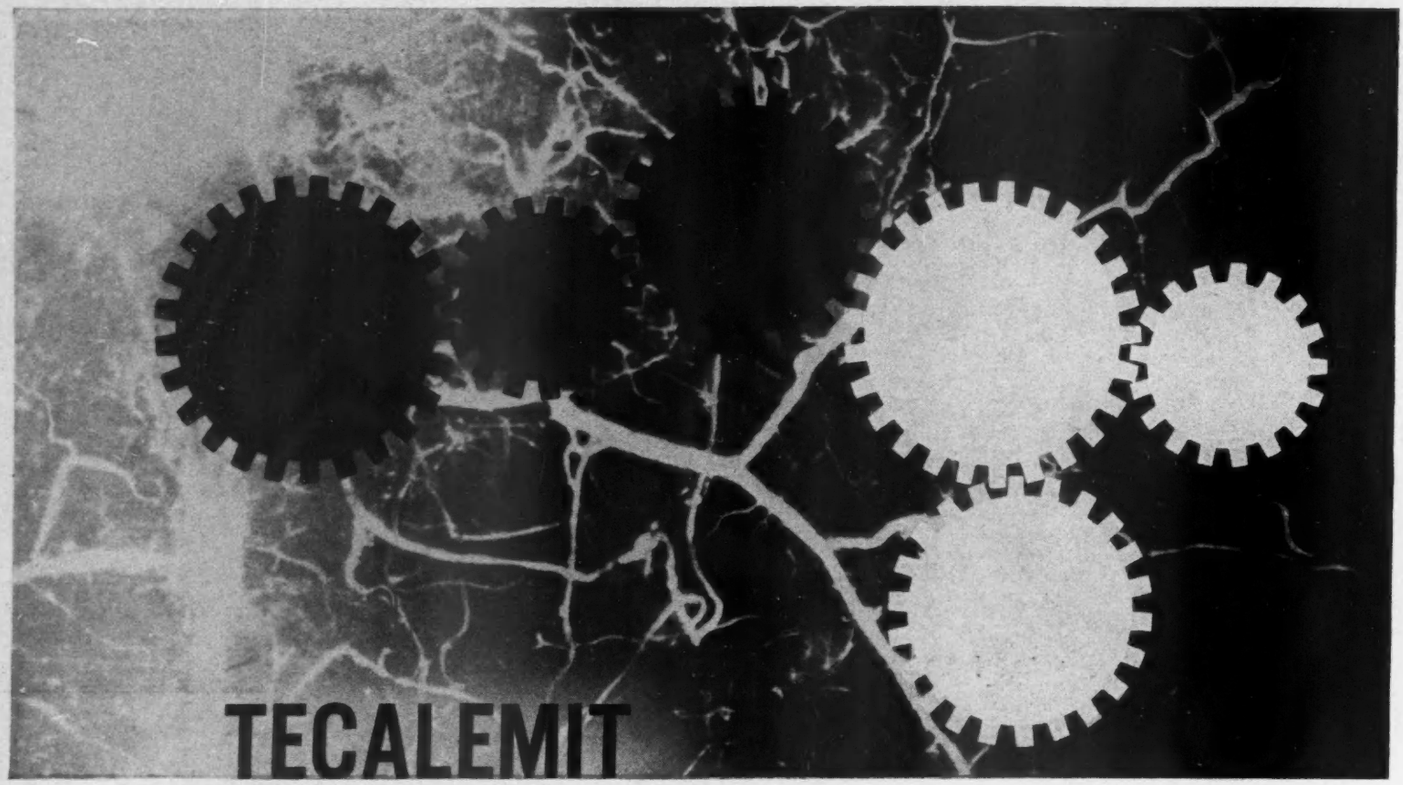

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Tecalemit Mechanical Lubrication Systems save power, lubricant and labour, and greatly increase the working life of your machines. They are infinitely flexible, and can be fitted into new designs or existing machinery.

With Tecalemit Mechanical Lubrication, bearings need no longer be accessible to hand oiling, and there will be no forgotten, neglected or under-oiled bearings to cause costly breakdowns and production hold-ups. Nor is there any danger of messy excess lubricant spoiling products. Tecalemit Mechanical Lubrication Systems provide accurately regulated lubrication to each individual bearing, at the correct intervals.

The BRENTFORD is a fully automatic multiline oiling system, with from one to twenty lines, each with its own independently regulated pump. The unit takes its power from the rotary or reciprocating motion of the machine it serves, or can be supplied with its own electric motor.

The BIJUR is a single-line system, with one central pump supplying up to 100 points. Each outlet is equipped with a metering valve which gives a pre-determined regulated supply of oil to each bearing.

Tecalemit Mechanical Lubrication can solve your problems and speed your production.

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Fill in this coupon and post it today. If you have a particular application or trouble-spot in mind, by all means enclose a note, a sketch or a drawing. You will be under no obligation whatsoever.

Please send me full information on:—

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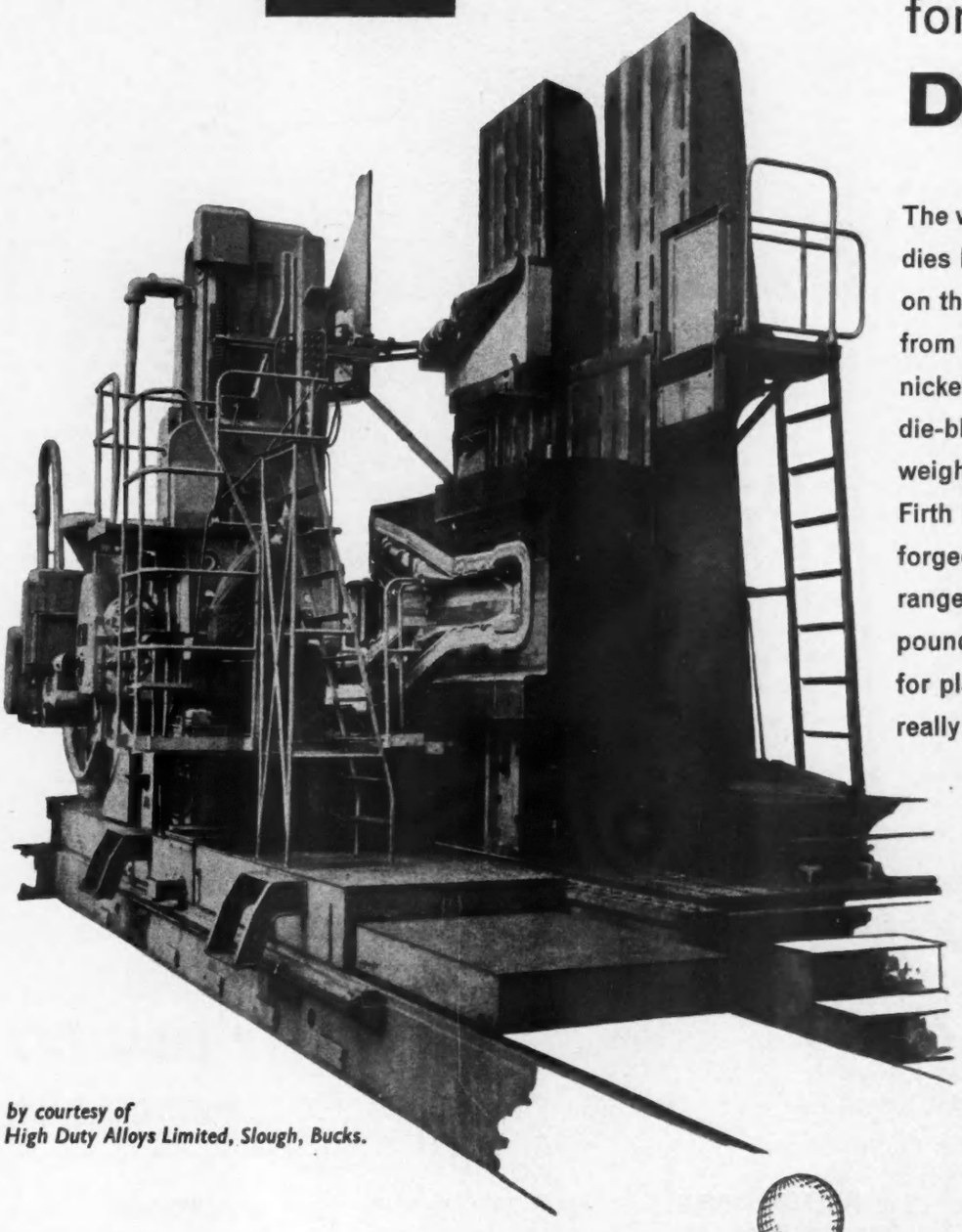
T.714

Special Alloy Steels for Dies



by courtesy of
High Duty Alloys Limited, Slough, Bucks.

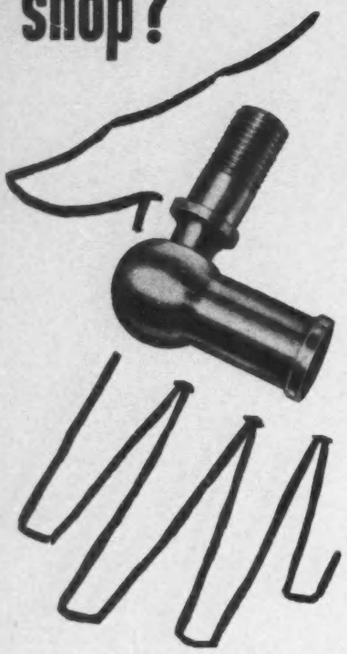
The value of the finished dies being die-sunk on this machine may be gauged from the fact that the Firth Brown nickel-chrome-molybdenum steel die-blocks have an unmachined weight of 43 tons.
Firth Brown die-blocks forged from special alloy steels range in size from a few pounds weight for small dies for plastics to the really large dies shown here.

FIRTH BROWN

ALLOY STEELMAKERS · FORGEMASTERS · STEEL FOUNDERS · HEAVY ENGINEERS

THOS. FIRTH & JOHN BROWN LIMITED · SHEFFIELD · ENGLAND

Pressure in your machine shop?



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The repetition people

Why overload your machine shop when you can "farm out" the bulk of your repetition work. It is usually more economical to call on FORDSMITH the repetition specialists. They are fully equipped to deal quickly and efficiently with your immediate problems. So, for all types of Capstan, Milling and Drilling work, etc. — remember FORDSMITH of Manchester are the best people to deal with.

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Hadfield Street Works,
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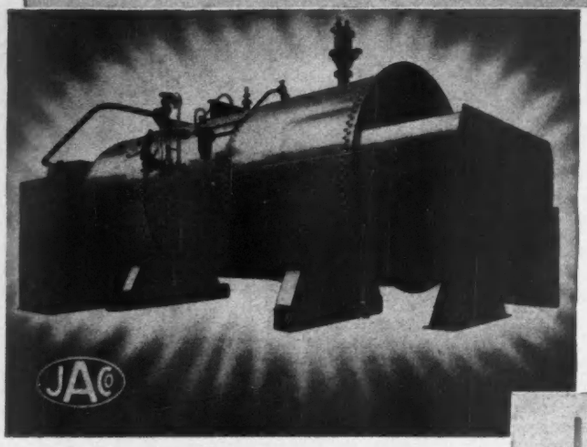
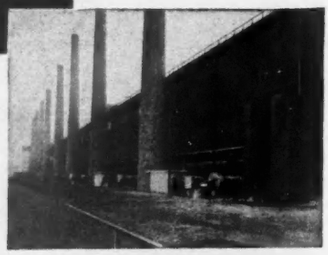
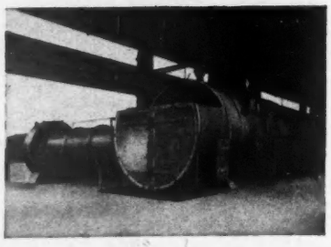
F2.

JOSEPH ADAMSON
Waste Heat Boilers



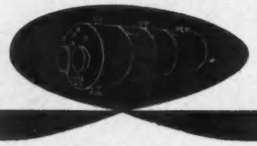




The Joseph Adamson Waste Heat Boiler is designed to make efficient use of the waste gases leaving open-hearth furnaces, reheating furnaces, soaking pits, gas retorts, etc.

The straight-through fire tubes have a high ratio of length to bore, giving about 90% tube efficiency and providing a large area of heating surface in a comparatively small space. Brickwork setting is not required and air infiltration is thus avoided.

A feature of Joseph Adamson Waste Heat Boilers is that a special cleaning device can be provided in the outlet chamber to allow the tubes to be cleaned while the boiler is at work.



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Fuel tanks, elevators, tail planes, pressings, fabrications, in all metals.

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RELIABLE.....

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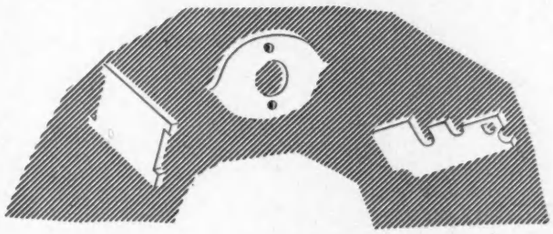

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These are only a few of its hundred and
one uses. You will think of many
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see us for dust

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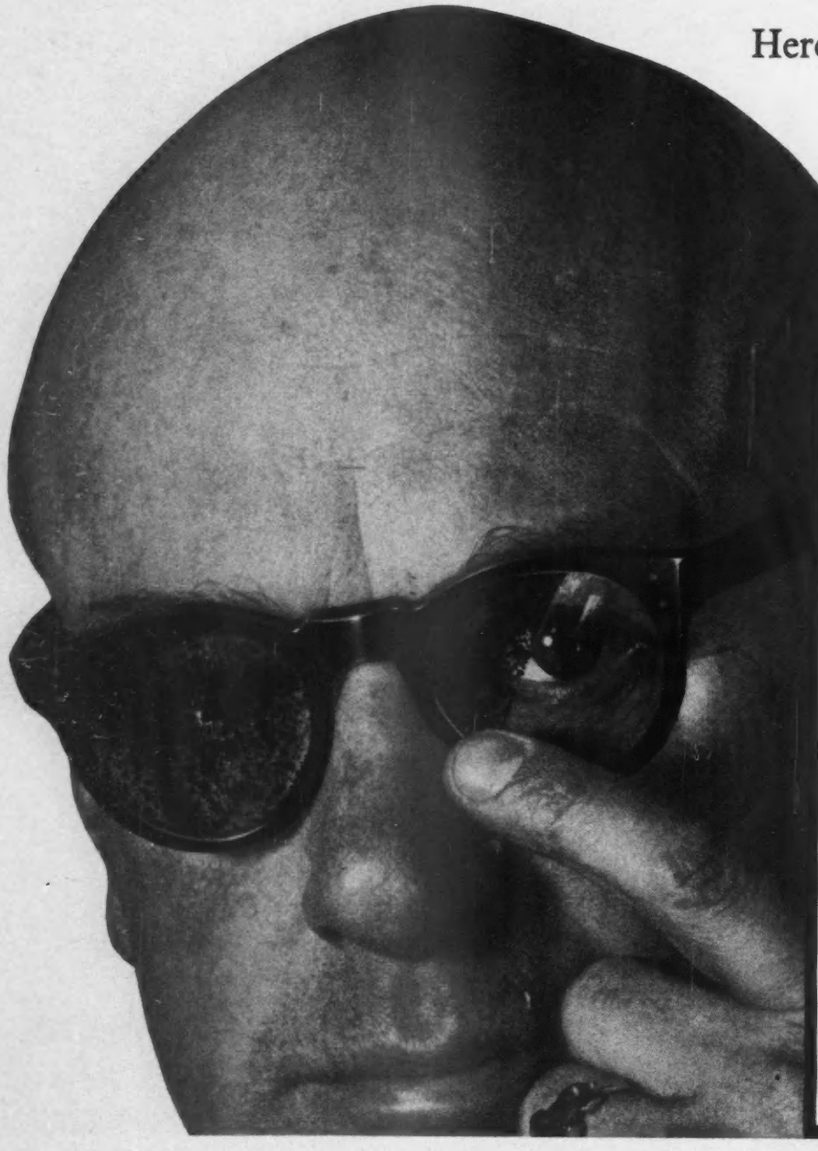

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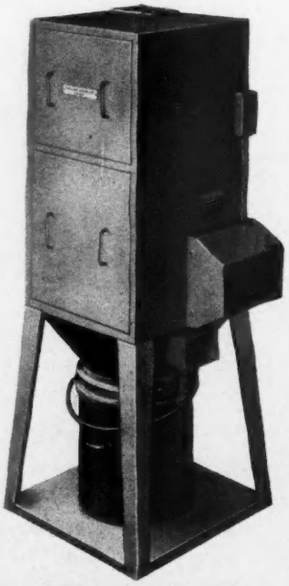

Finally—NO MORE HAND SHAKING!

Every Unimaster incorporates our new 'push button' filter cleaning method.

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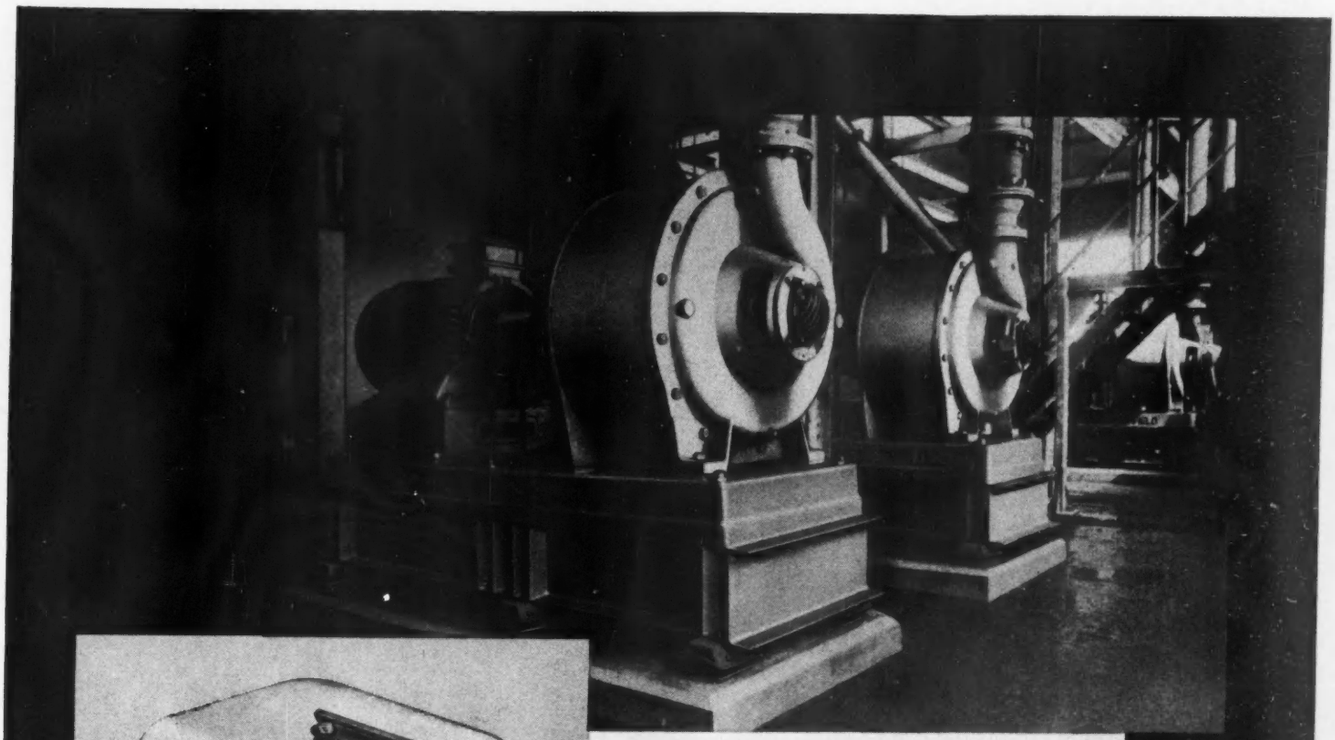

CUSHYFOOT MOUNTINGS are suitable for every kind of machine and are not affected by dust, grit or water.

Brinelling of ball-bearings CURED BY METALASTIK

At a well-known colliery of the N.C.B., vibration from adjoining machines caused Brinell-like fretting of the bearings of the motors of four main blowers while they were standing idle, leading to expensive replacement and lack of availability. When Metalastik 'Cushyfoot' resilient mountings were put under the blowers the trouble ceased.

Metalastik resilient mountings not only protect the machines they carry, but also safeguard other machines and reduce the vibration-and-noise nuisance to people working or living nearby.

METALASTIK

METALASTIK LTD., LEICESTER

H3

STEAM FOR **POWER**

A complete industrial power station by Simon-Carves

STEAM FOR **PROCESS**

At a colliery in South Wales, Simon-Carves have designed and constructed this complete industrial power station. The contract included the three tri-drum twin-circulation type boilers with superheaters and economisers, water treatment plant, de-aerators, panels and instruments, fuel and ash handling plants, chimney, cooling tower, and all building and civil engineering work.
Simon-Carves were also responsible for the design and installation of the whole of the electrical equipment in the power house, and the installation of the two double pass-out and condensing turbo-alternators and switch-gear.
Steam is extracted at two pressure levels from the turbines for process plant in connection with the new coke ovens at the colliery. Simon-Carves have undertaken the design and construction of a wide variety of industrial steam plants and can offer a comprehensive designing and contracting service which enables them to accept complete responsibility for contracts of this kind.

COMPLETE INDUSTRIAL POWER PLANT BY

Simon-Carves Ltd

SIMON ENGINEERING GROUP

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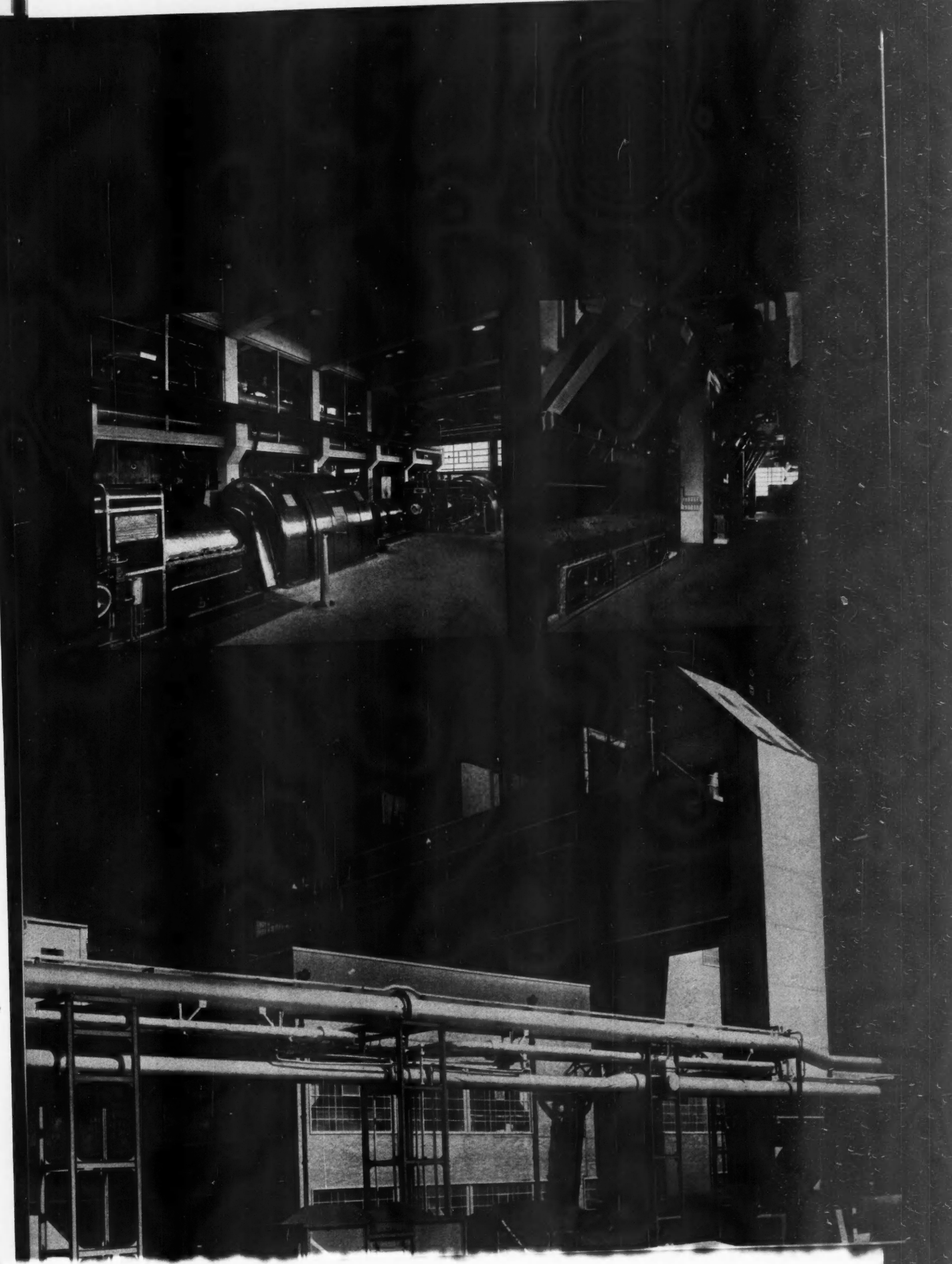
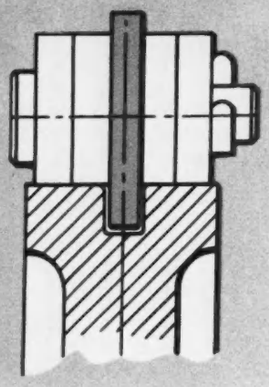


British Patent
No: 818085

German Patent
No: 1,799,032



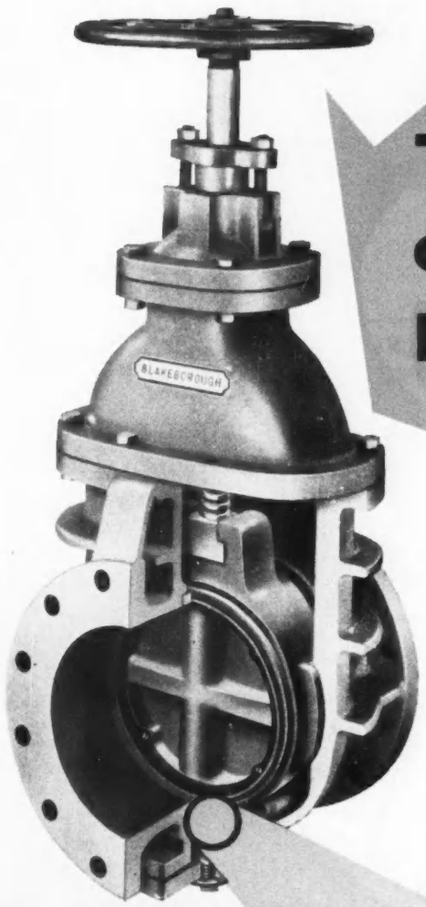
ISO-LINK
GUIDED
BALANCE CHAIN

This is a new member of the Iso-link family of balance chains, with a central guiding link. This—as is shown in the sectional sketch—engages with a groove in the guide pulley. This arrangement simplifies machining and saves space on the width and O.D. of the guide pulley.

Other Iso-link balance chains are available, for breaking loads from 2150 lb. to 23 tons. The heavier chains, with breaking loads ranging from 3.4 tons upwards, have 'stops' which make them non-kinking.

THE ISO-SPEEDIC COMPANY LTD., WARWICK

Iso-Link

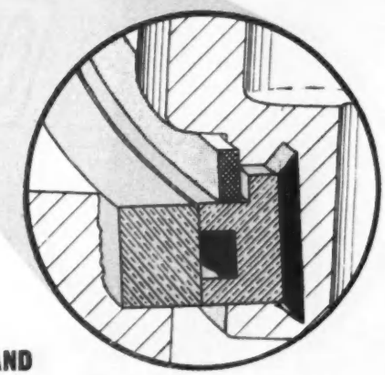


The Oil Tanker Valve of the Future

Proved under severe test conditions and by actual service trials, the Blakeborough "Flexi-Ring" principle has emerged as the one comple.e answer to gate valve problems on oil cargo duty. In performance it sets a new standard for the future, not only in the tanker field but for a variety of other applications where conditions of similar difficulty obtain.

BLAKEBOROUGH FLEXI-RING GATE VALVE

- Dead-tight shut-off on both upstream and downstream faces.
- Leak-proof seating maintained despite grit, scale, etc., or body distortion due to pipe movements.
- Ease of operation.
- Simple replacement of "Flexi-Ring" components if ever necessary.
- Enhanced durability.



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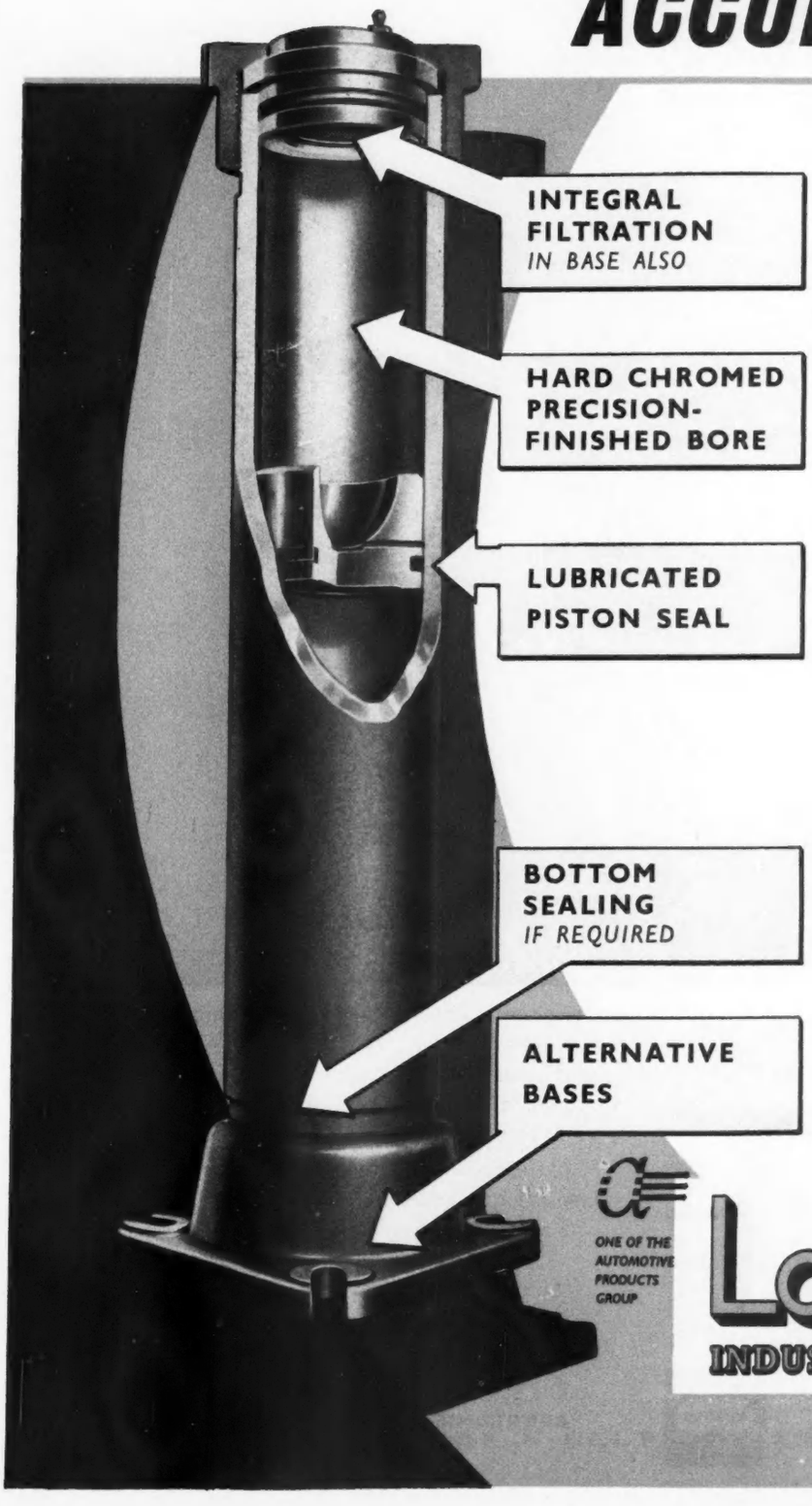
LOCKHEED HYDRAULIC ACCUMULATORS



Incorporating many valuable features, these piston-separator type accumulators are available in capacities from $\frac{1}{4}$ gallon to 12 gallons and are suitable for working pressures up to 3,000 p.s.i.

USE THEM . . .

- ★ to supplement pump in satisfying widely fluctuating power demands
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- ★ to absorb fluid displaced by mechanical shock.

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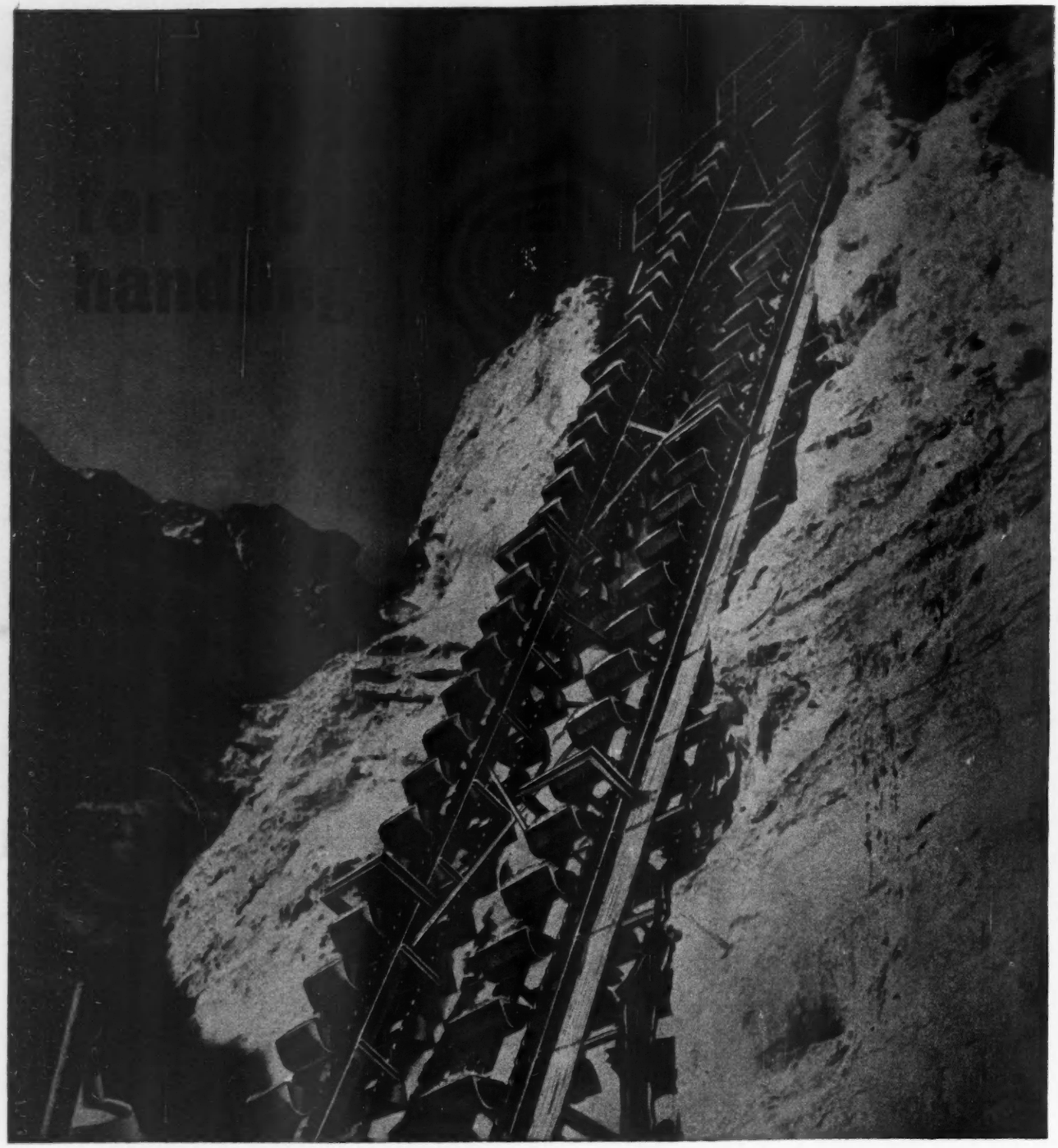

Quarries are the scene of some of man's most impressive undertakings: here are found mammoth machines and plant on a huge scale. Renold chains, of the heaviest and most rugged designs, are widely employed and make a notable contribution to the success and efficiency of the industry. **Renold chains are everywhere.**

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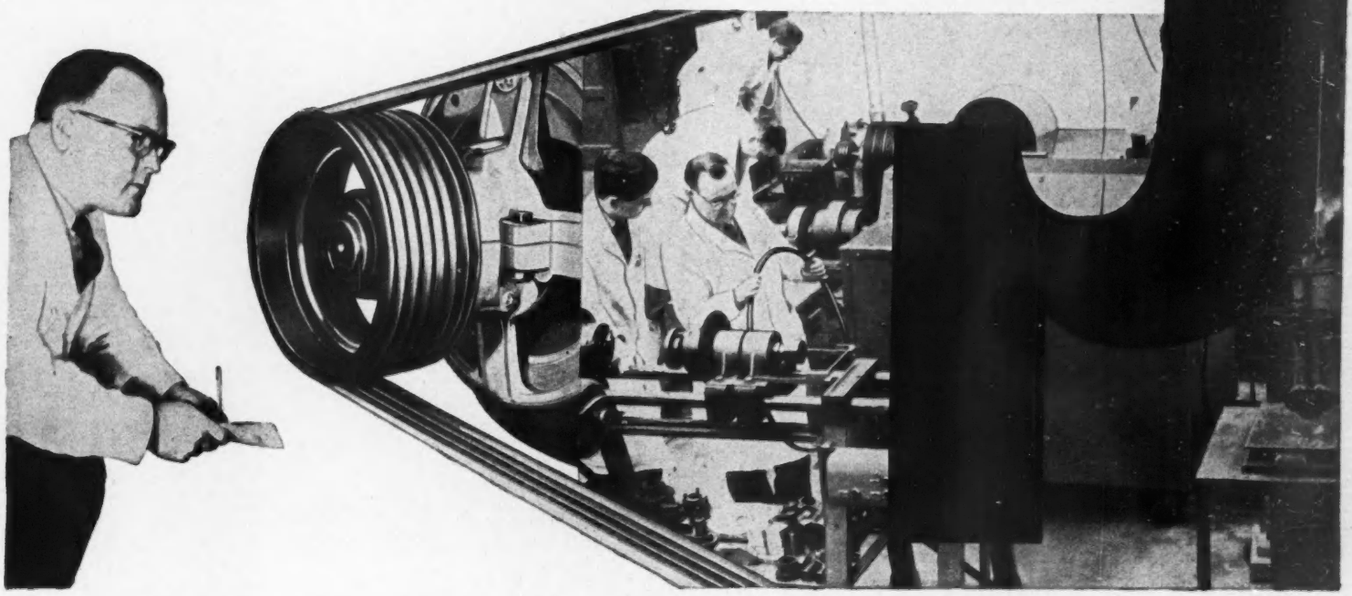
IN 1961 OUR CENTENARY YEAR



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We have made our own V-Belts since 1936, and our own pulleys since 1938. We have full control of and responsibility for the constant improvements put into both. Our Engineering Laboratory began its night and day work in 1951 testing, proving, discarding, discovering. Higher horsepower ratings came to Fenner V-Belt users from it in 1955 and Premium V-Belts using Terylene two years later. This significant leadership will soon be reflected in the British Standard horsepower ratings.

Fenner drive starts with the Managing Director; dynamic, questing, never satisfied, looking to the next nine years, and not at the last ninety-nine.
The reason why Fenner makes better products for everyone — and sets the pace.

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Consulting Engineers :—Messrs. Ward Whitfield & Son, Trowbridge.

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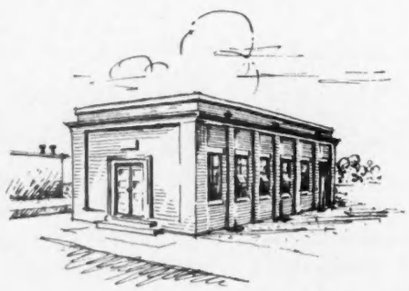
Tangyes Limited are proud of their long association with Consulting Engineers and Surveyors and numerous public servants to whom we owe so much.



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For gases such as Town, Natural, Sludge, producer, Mansfield, Propane, Butane, and proprietary mixtures—Calorgas, Bottogas, and Scottish Rural Gas etc.

Each burner is fitted with a suitable calibrated gas jet, ensuring perfect controlled flames that will turn down with no flashing back.

Models for laboratory or industrial use.

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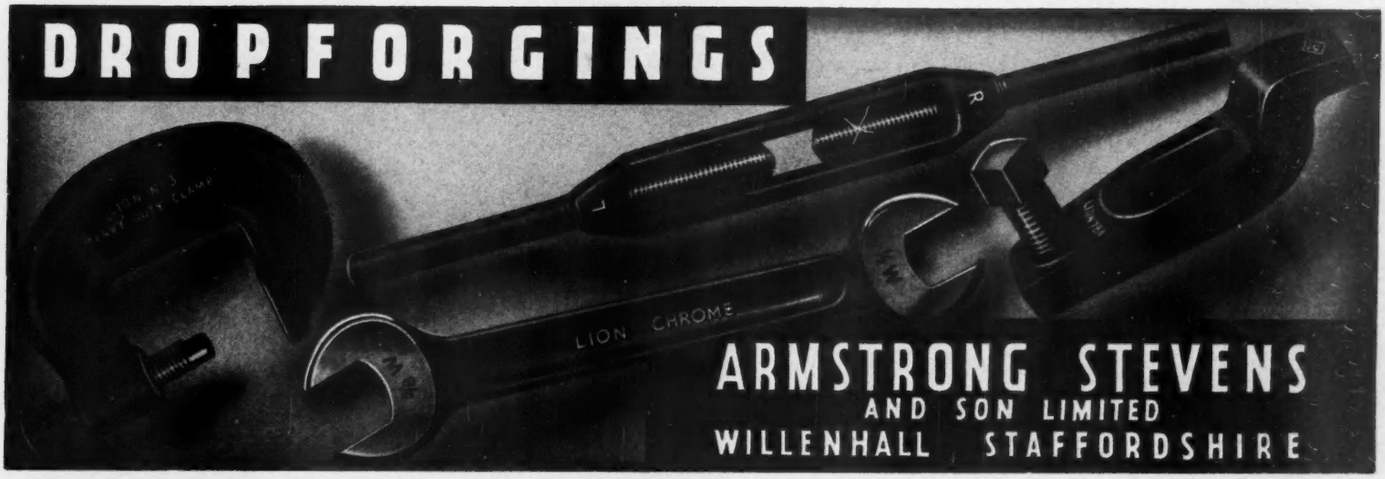

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THIS
is a masterpiece

Because it's in the hands of a master craftsman. This Marston light alloy industrial heat-exchanger is being made* with the same skill and attention to detail which typifies all Marston products. If you're contemplating engineering, chemical, petroleum or nuclear power plant that calls for components to unusual specifications, consult us at the design stage: our experts can contribute much to the smooth, speedy and economical execution of your plans.

Process plant
Bursting discs
Pressure vessels
Special-purpose machines
Pipework
Heat-exchangers

in aluminium, titanium and other non-ferrous metals

*For British Oxygen Engineering Ltd.

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MARSTON EXCELSIOR LIMITED
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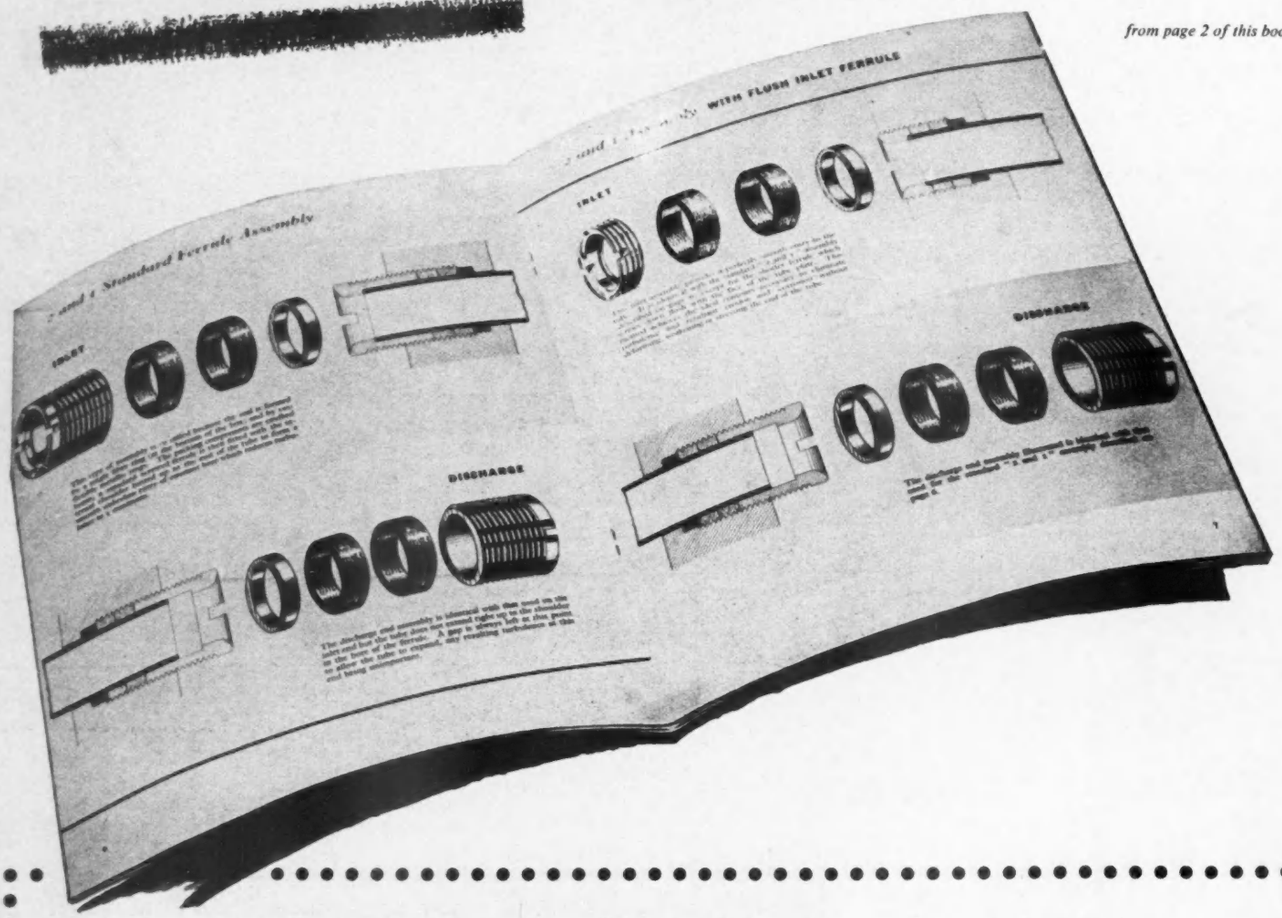
Fordhouses, Wolverhampton

MAR.280

Quote!

"The CRANE Condenser Process was developed so that the tubes of conventional straight tube heat exchangers might be secured and effectively sealed off in their tube plates, while still allowing them freedom to move axially—**without deformation or damage to the tube ends.**"

from page 2 of this booklet.



This is a booklet which has been produced for all engineers who are concerned with the manufacture or the performance of straight tube heat exchangers, and especially marine and land based condensers.

The contents of the booklet include a description of the CRANE Condenser Process, the problems which arise in sealing against leakage in all conditions of marine and land service, descriptions of various assemblies, and other information which is allied to the subject.

Copies of the CRANE Condenser Process Booklet can be obtained from Crane Packing Limited of Slough, Bucks, England.

ISSUED BY THE CONDENSER PROCESS DIVISION OF

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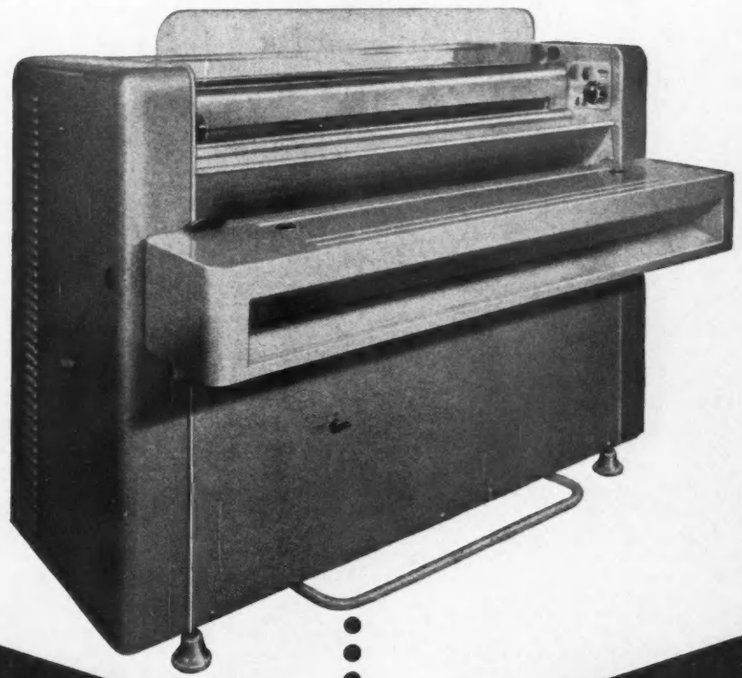

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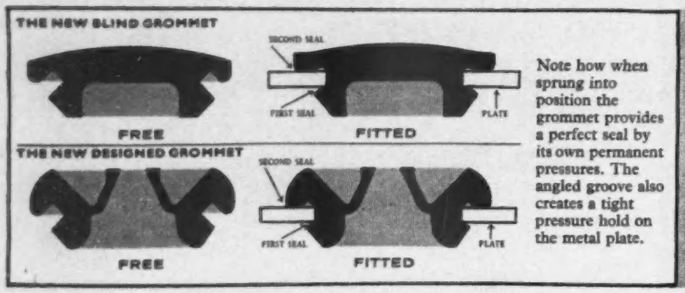
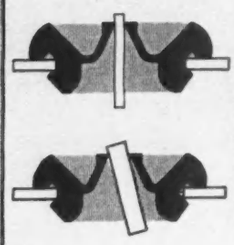
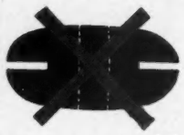


Note how when sprung into position the grommet provides a perfect seal by its own permanent pressures. The angled groove also creates a tight pressure hold on the metal plate.



A useful feature of this cable grommet is that by reason of the designed taper of the cable entry and the flexibility of the web, a considerable angle of cable entry and a variety of cable size, are possible. This avoids necessity for special grommets with angled bores.



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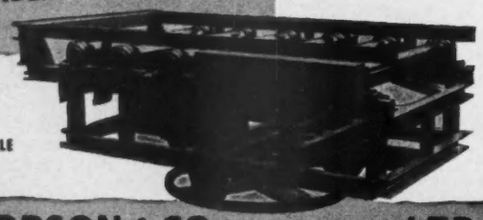

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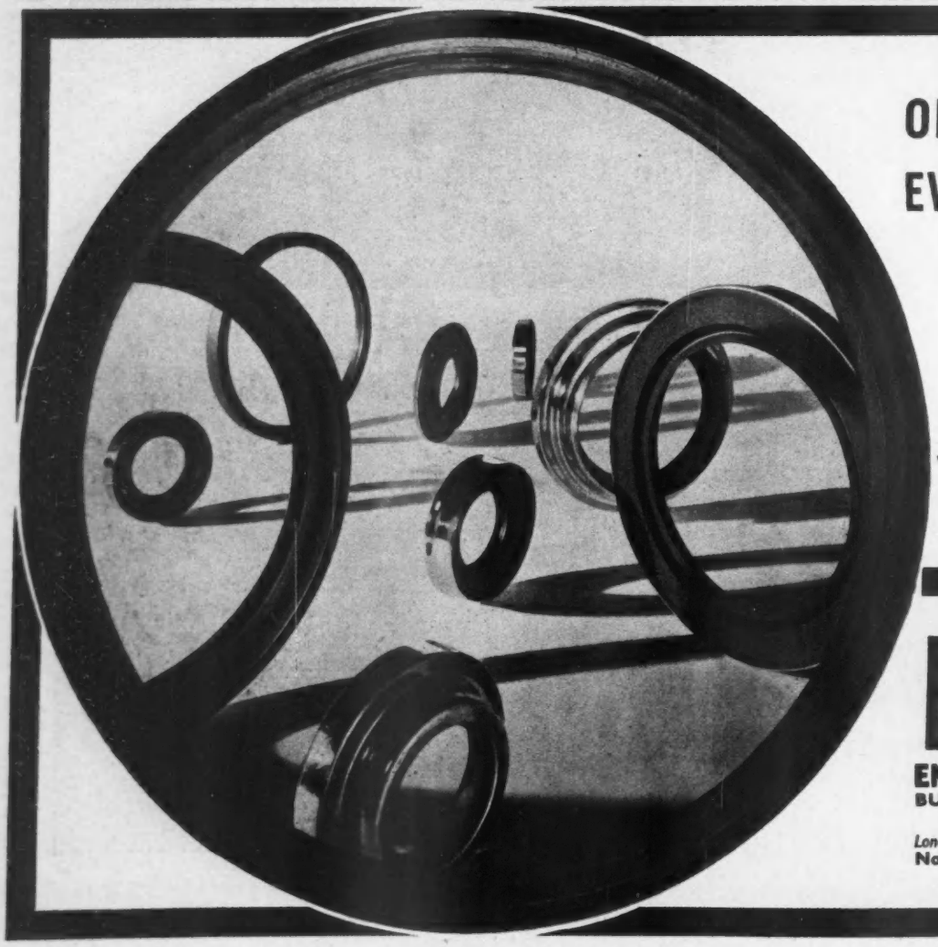

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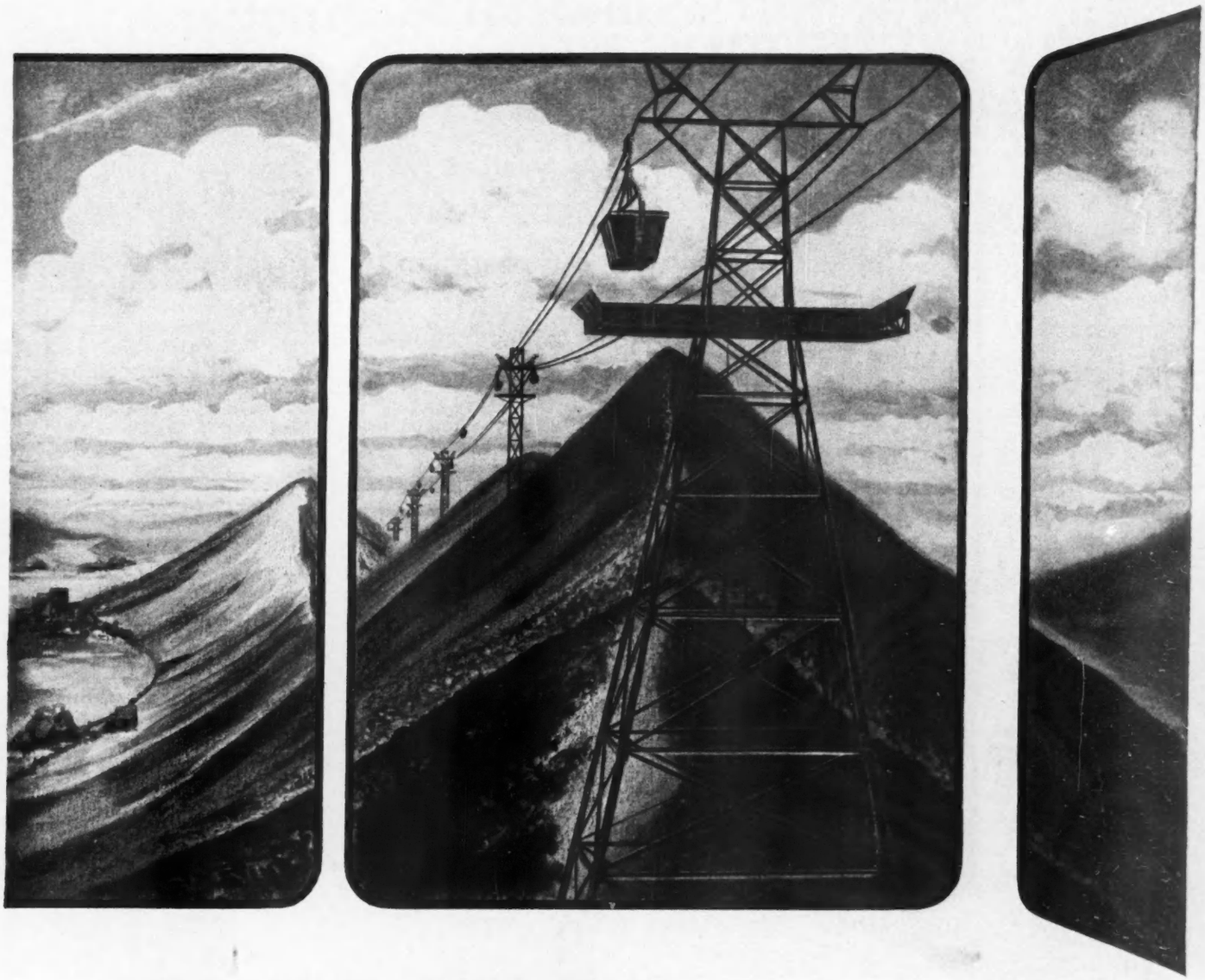

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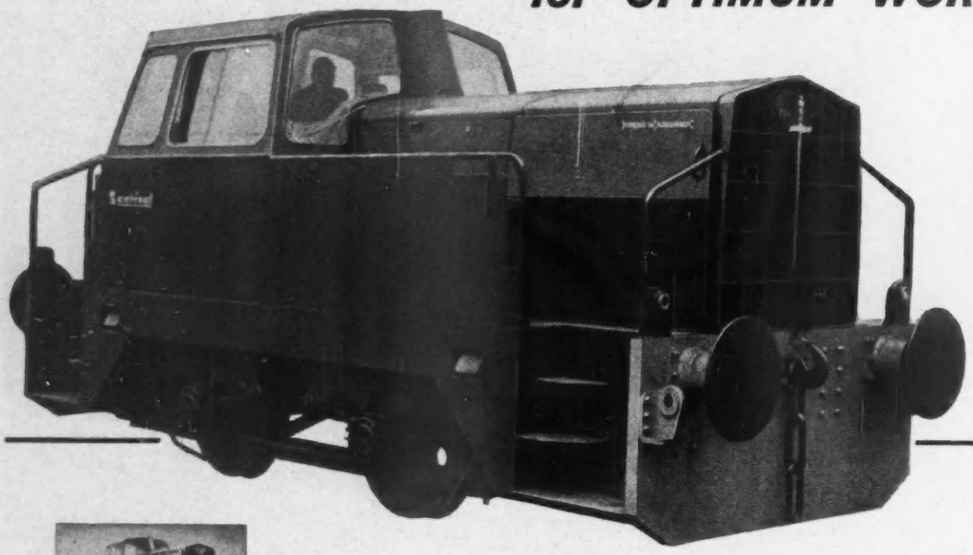

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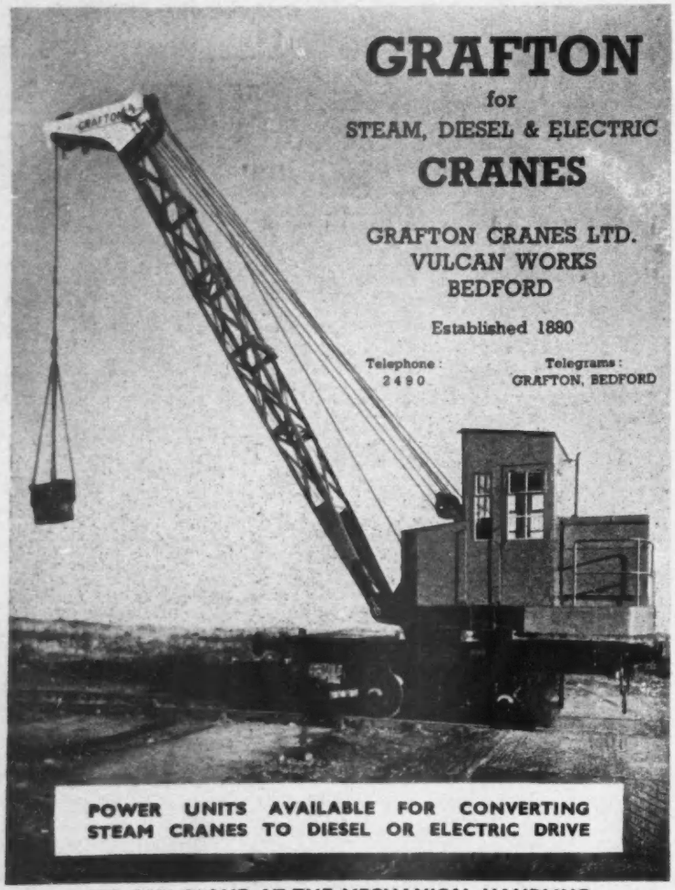

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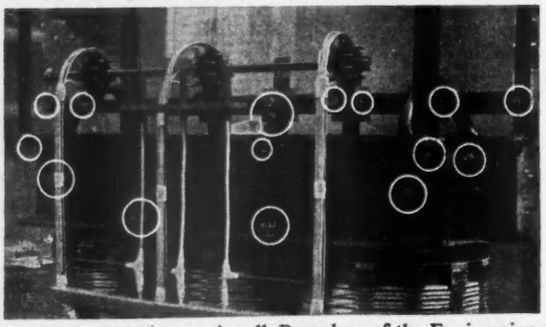

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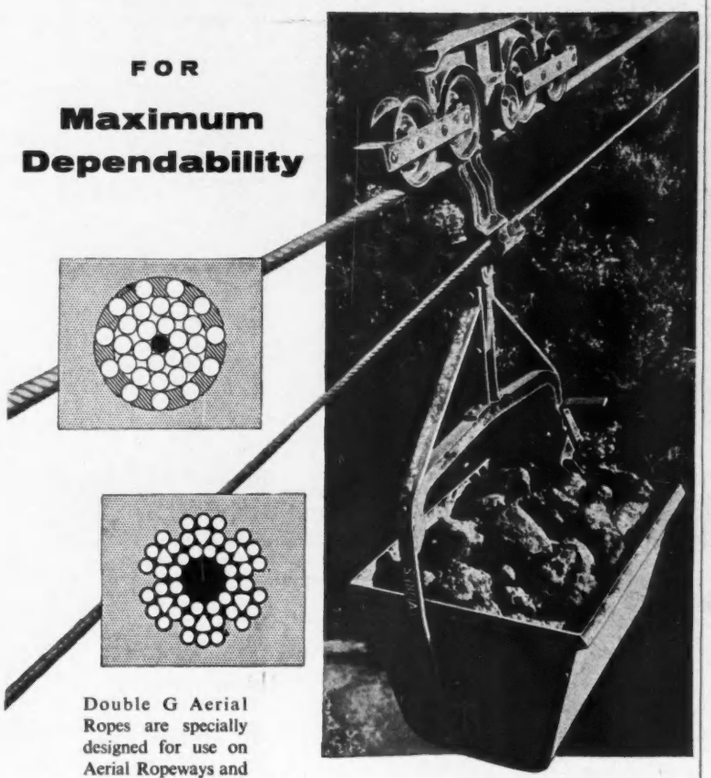

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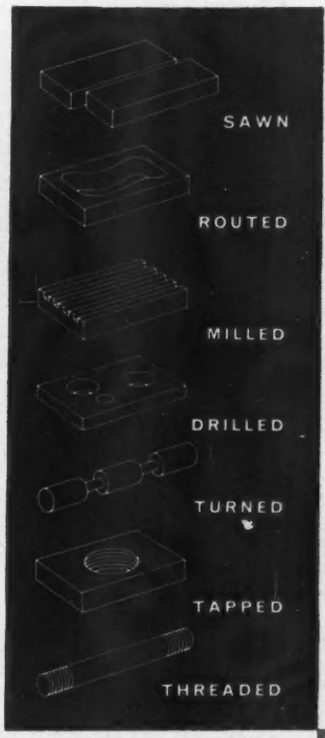

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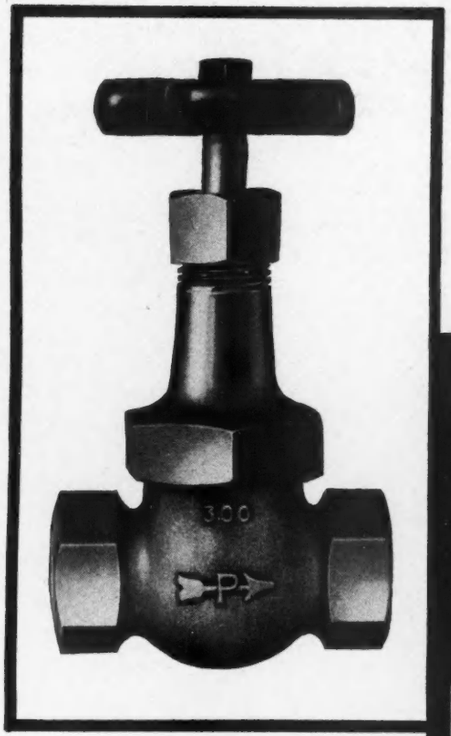

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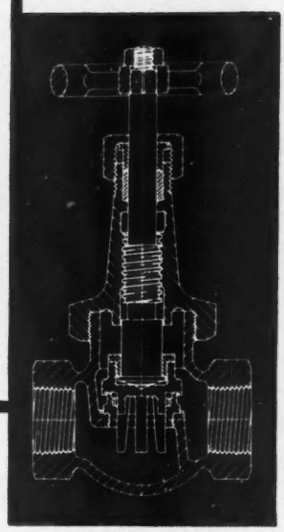

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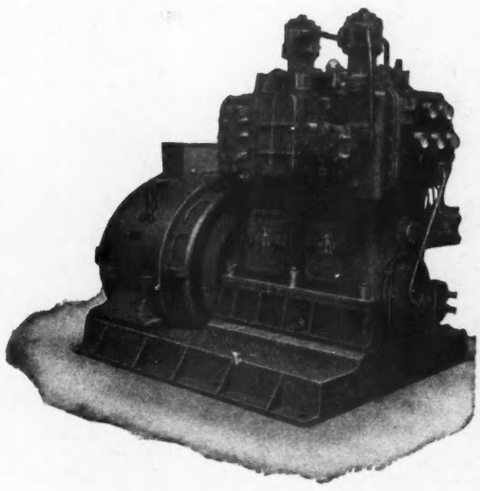

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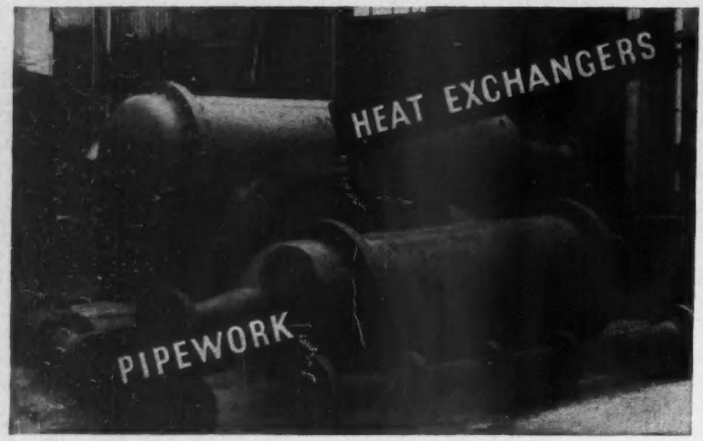

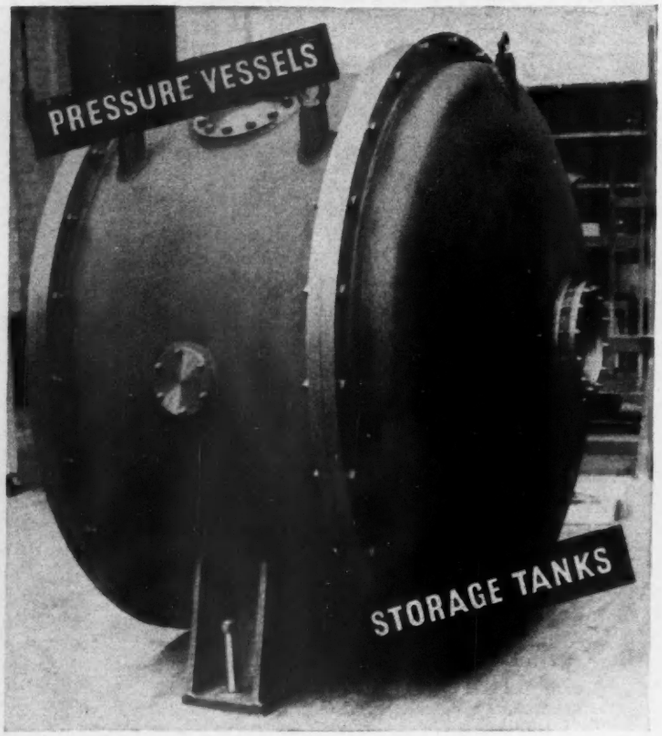

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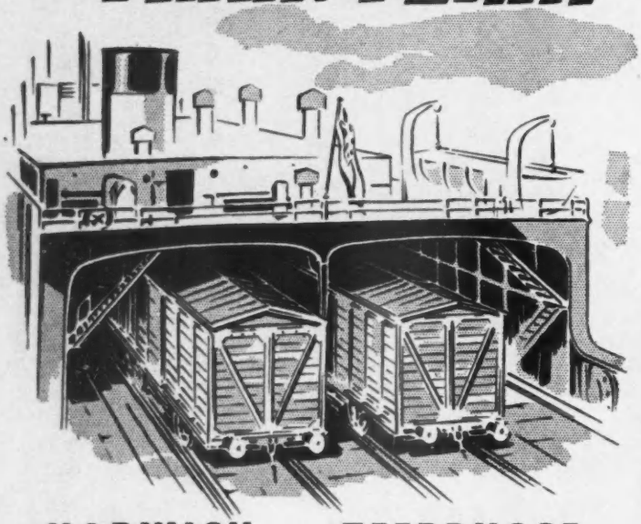

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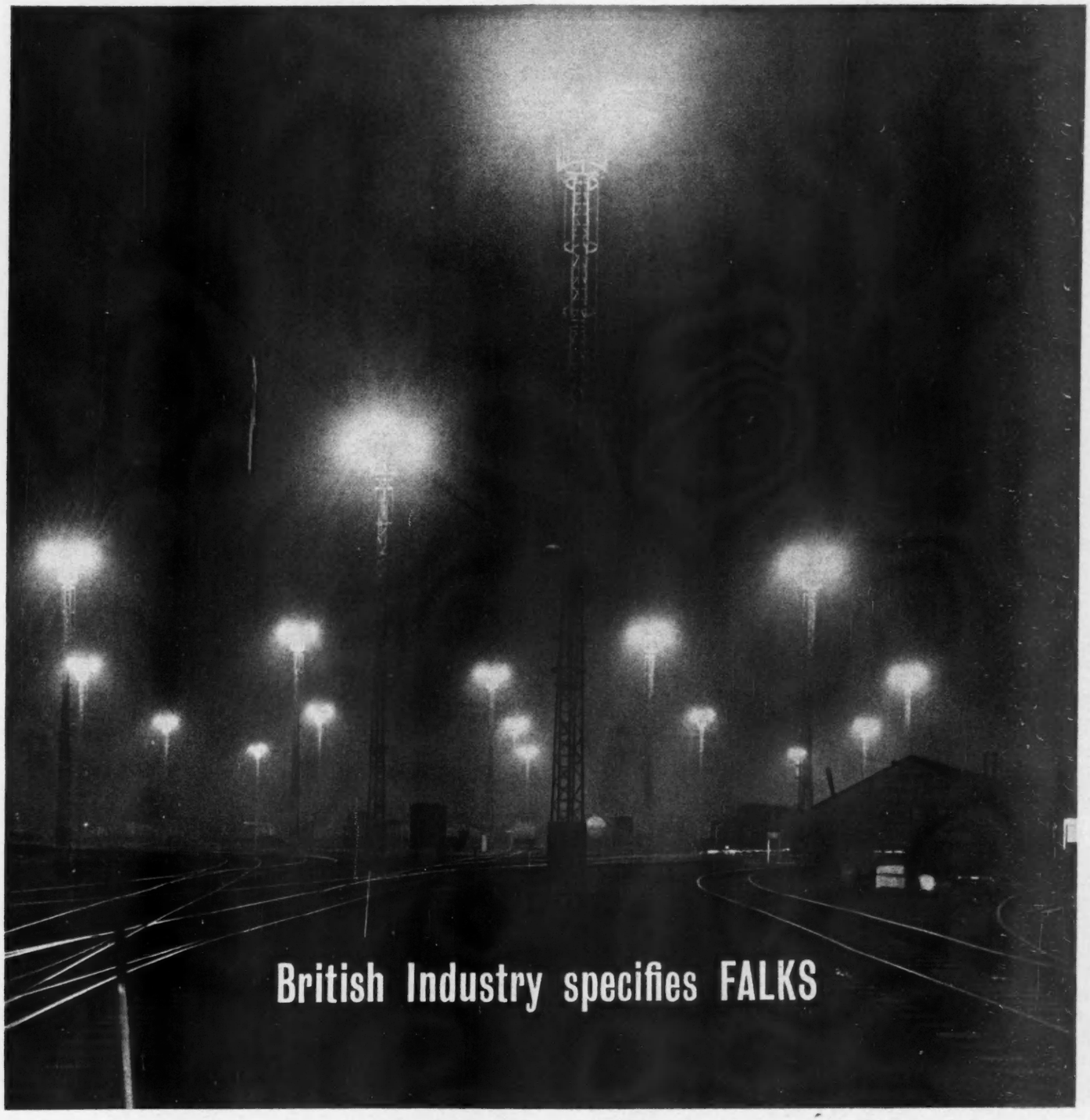

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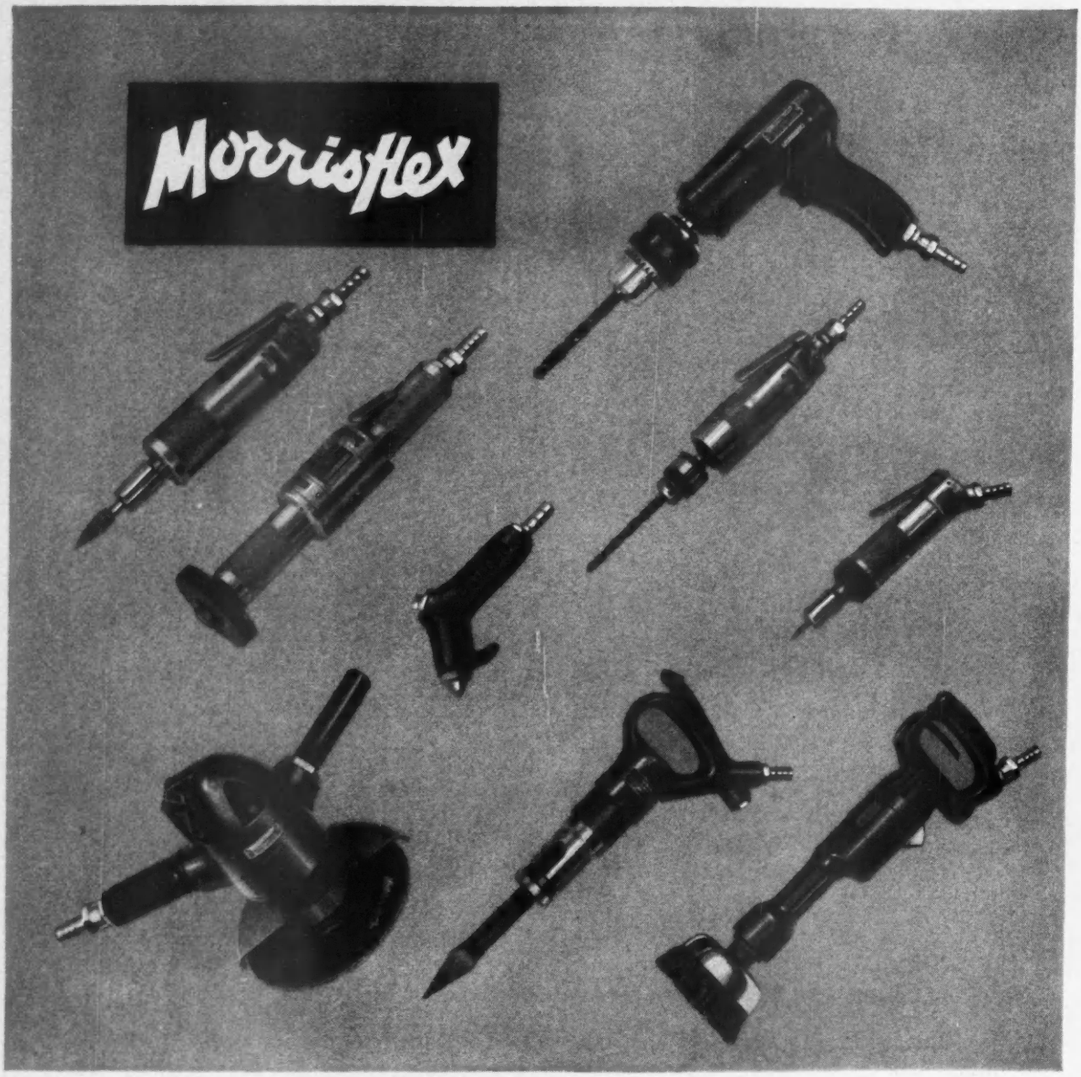

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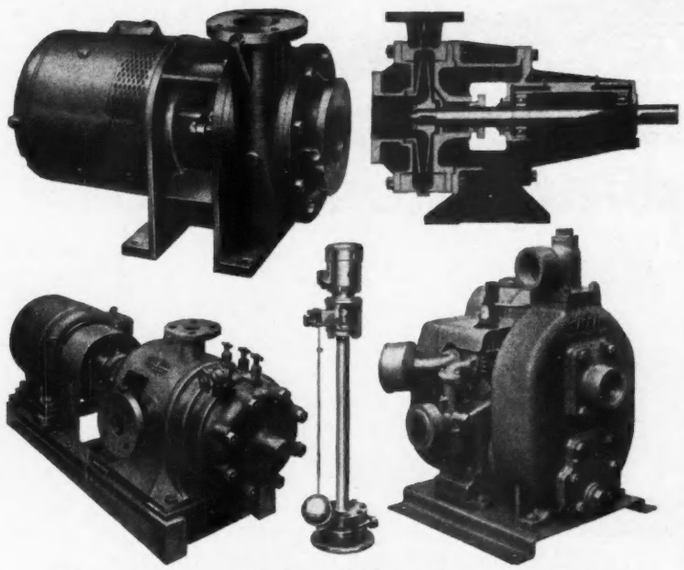

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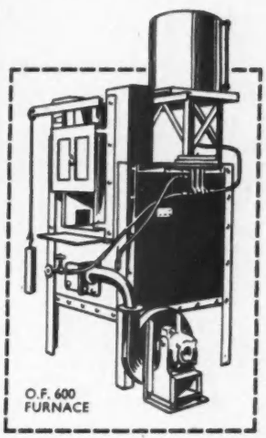

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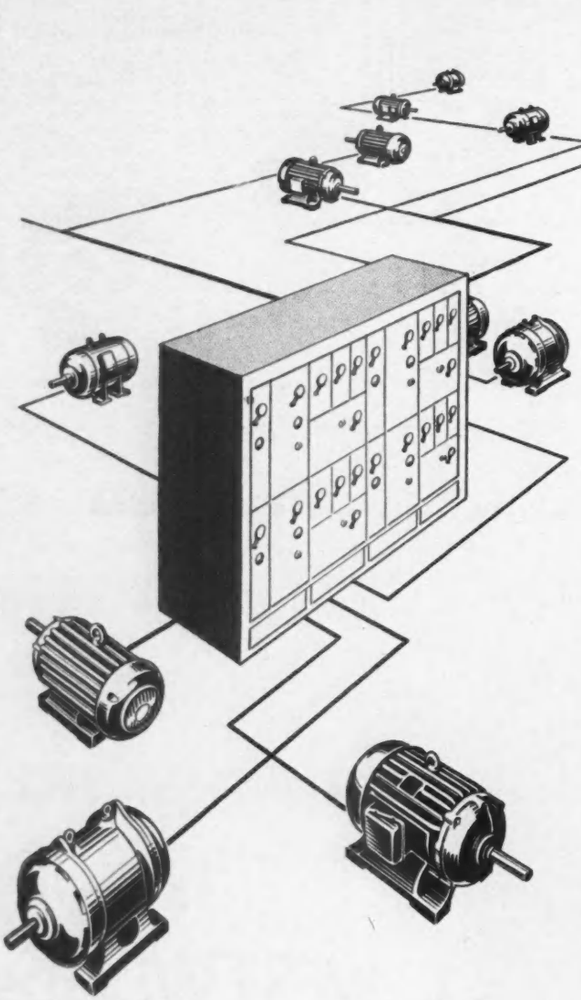

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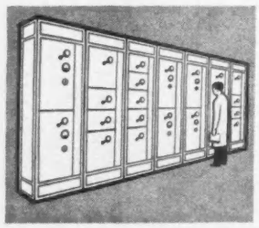

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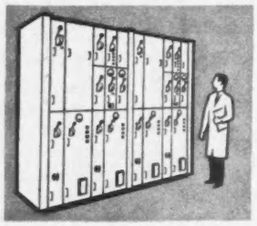

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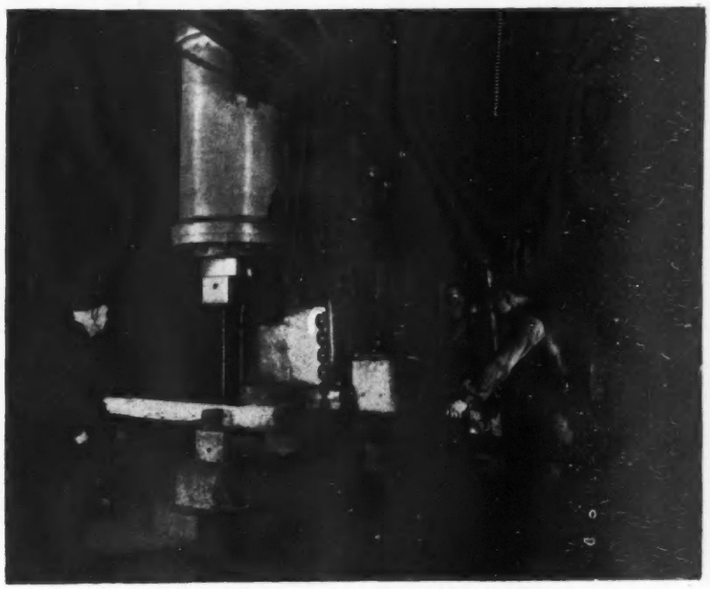

20 cwt. "Clear Space" Hammer. Messrs. G. & J. Weir Ltd., Glasgow.

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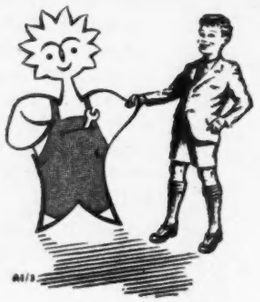

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